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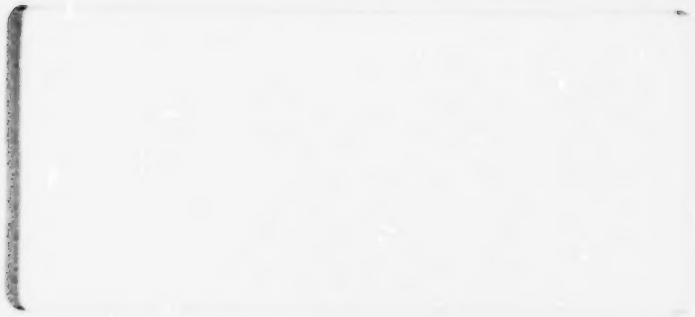

Manitoba
Environment
and Workplace
Safety and Health

MG–8159

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DATE: May 6, 1987

Brandon Thermal Generating Station
Particulate Emissions From The
Breeching Of Power Boiler Unit 5
1986

Air Pollution Control,
Environmental Control Services,
Department of Environment and
Workplace Safety and Health.

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ABSTRACT

During 1986 two source emission surveys were conducted on boiler Unit 5 at Manitoba Hydro's Brandon Thermal Generating Station, located in the City of Brandon, Manitoba. The average concentration of particulate matter at the Unit 5B breeching, when corrected to 12 percent CO_2, was 3.83 grams per dry standard* cubic metre (g/dscm) for the first survey and 1.99 g/dscm for the second survey.

In 1986 the Brandon Station was utilized for peak load requirements only when other sources of power were not available. Consequently as annual electrical power generation was well below the amount specified for Clean Environment Commission Order No. 1039VC Clause 1(c), the particulate emission limit was not in effect for 1986.

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* temperature 25°C, pressure 760 mm Hg

INTRODUCTION

The Brandon Thermal Generating Station is the largest of the two thermal generating stations in the Manitoba Hydro system. The station, which is located in the City of Brandon, Manitoba, is capable of producing 237,000 kW of electrical power.

In 1957 one 33,000 kW generator went into service. During the following year three additional 33,000 kW generators were commissioned. In 1969 the station capacity was expanded with the installation of a 105,000 kW generator.

CEC order No. 1039, dated August 22, 1984 was issued to Manitoba Hydro for the continued operation of the Brandon Thermal Generating Station complex. That order was replaced by varied Order No. 1039VC on July 17, 1986.

Since its commission in 1957 the station has supplemented Manitoba Hydro's hydraulic electrical generating capability. The generators can be brought on line whenever river water flow is low, peak load demand exceeds the hydro electric generating capacity or in emergency situations.

PROCESS DESCRIPTION

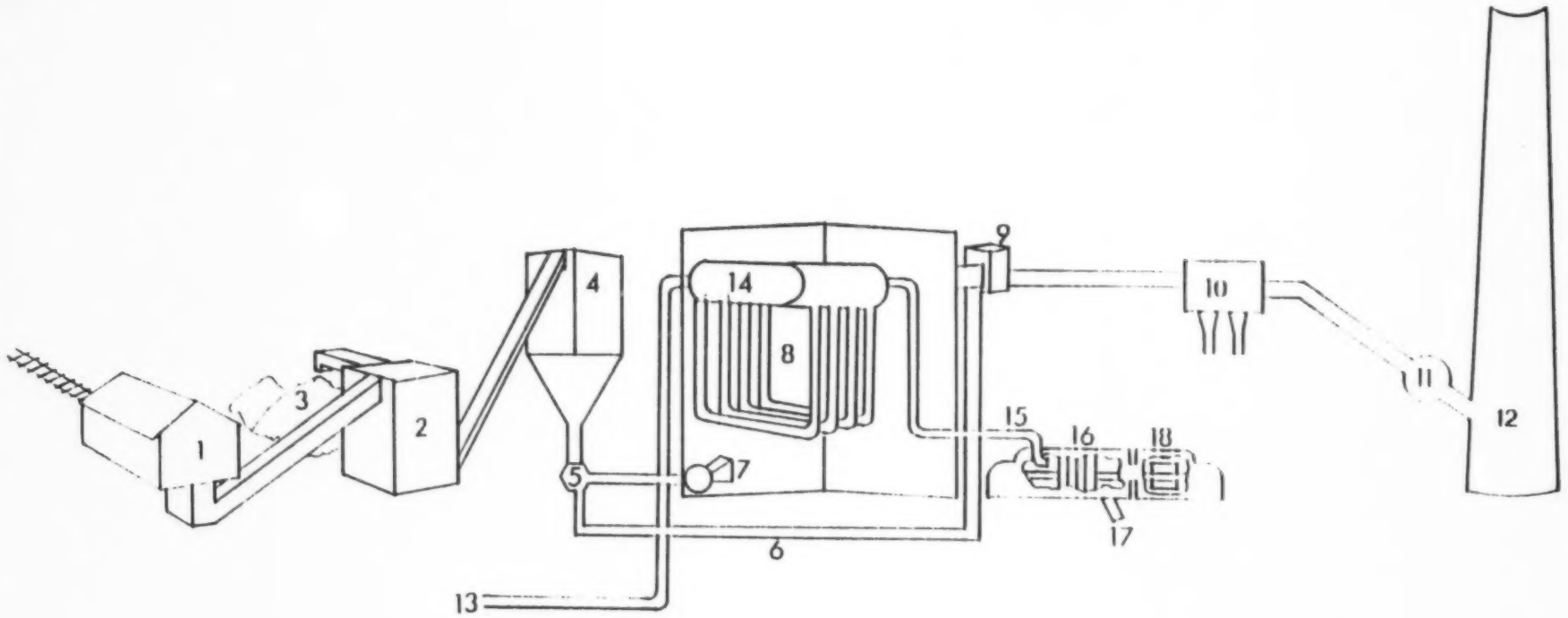
Thermal generation of electricity is a process where water is heated to produce steam which is fed to a steam turbine. A generator attached to the steam turbine is used to produce electrical energy. The basic system at the Brandon Thermal Generating Station is explained below and illustrated in Figure 1.

Lignite coal (0.5 percent average sulfur content) is shipped by railroad from Estevan, Saskatchewan to the unloading shed at the generating station where it is unloaded and falls through a floor grate. The coal is then conveyed to the crusher house where it is either stockpiled outside or crushed to a maximum diameter of 20 mm (3/4") and sent to a coal bunker. Coal released from the bunker is automatically weighed, pulverized into a very fine powder, and then fed by pre-heated high velocity air into the boilers where it is burned.

Hot flue gases from the boiler combustion chambers are then fed into multiclone mechanical dust collectors. Ash from the boilers and the multiclones is then sluiced to an ash lagoon.

The Brandon Generating station has five coal burning boilers which operate five steam turbine generators. At present boiler unit 4 is not operating a steam turbine.

Boiler units 1-4 each have a maximum continuous operating capacity of 325,000 lbs/hr of steam at 625 psi and 825°F. Boiler coal consumption per unit is 30 tons/hr. The steam turbines coupled to



1. Unloading Shed
2. Crusher House
3. Coal Stockpile
4. Coal Hopper
5. Pulverizer
6. Air Line
7. Burner
8. Combustion Chamber
9. Air Preheater
10. Multiclones
11. Induced Draft Fan
12. Stack
13. Boiler Water Inlet
14. Boiler Drum
15. Steam Line
16. Steam Turbine
17. Steam Exhaust
18. Electrical

FIGURE 1. BASIC COMPONENTS OF A THERMO-ELECTRIC GENERATING STATION

boilers 1-4 were manufactured by Metropoliton Vickers and each is rated at 33,000 kW. Flue gases from these boilers exit through two 76 m (249 ft.) reinforced concrete stacks.

Boiler unit 5 has a maximum continuous operating capacity of 875,000 lbs/hr of steam at 1250 psi and 950°F. Boiler coal consumption is 80 tons/hr. The steam turbine coupled to boiler unit 5 was manufactured by Brown Boveri and is rated at 105,000 kW. Flue gases exit through a single 107 m (351 ft.) reinforced concrete stack.

PROCESS SCHEDULE

Unit 5 was sampled during normal training and testing conditions. Process information supplied by Manitoba Hydro can be found in Tables 1 to 3 for tests 1 to 3 and Tables 4 to 6 for tests 4 to 6.

TABLE 1. UNIT 5 PRODUCTION DURING TEST 1.

TIME	TURBINE LOAD					STEAM FLOW FT. H₂O	RELATIVE AIR FLOW	AIRHEATER OUTLET TEMPS		O₂
	INDICATED *	INTEGRATED	DIFFERENCE	UNIT TRANSFORMER	DIFFERENCE			A	B	
13:54	90.0	2591.1		76561.2	0.6	21.6	77%	310°C	320°C	2.6%
14:00	91.0	2592.0	0.9	76561.8	1.5	21.6	77	310	320	2.8
14:15	90.0	2594.3	2.3	76563.3	1.5	21.6	77	310	320	2.7
14:30	90.0	2596.5	2.2	76564.8	1.5	21.7	77	343	347	2.8
14:45	90.0	2598.8	2.3	76566.3	1.5	21.6	77.5	350	360	2.9
15:00	90.0	2601.0	2.2	76568.0	1.4	21.6	77	350	360	2.8
15:15	90.0	2603.3	2.3	76569.4	1.4	21.6	77	360	365	2.4
15:30	90.0	2605.5	2.3	76571.0	1.6	21.6	77	360	368	2.7
15:45	95.0	2607.8	2.3	76572.6	1.6	23.2	80	360	370	2.2
16:00	99.0	2610.1	2.3	76574.1	1.5	24.0	84	380	390	1.4
16:15	100.0	2612.4	2.3	76575.6	1.5	23.8	83	385	390	1.5
16:30	100.0	2614.9	2.5	76577.2	1.6	23.8	85	390	400	1.0

TABLE 2. UNIT 5 PRODUCTION DURING TEST 2.

TIME	TURBINE LOAD					STEAM FLOW FT. H₂O	RELATIVE AIR FLOW	AIRHEATER OUTLET TEMPS		O₂
	INDICATED *	INTEGRATED	DIFFERENCE	UNIT TRANSFORMER	DIFFERENCE			A	B	
18:30	90.0	2634.2		76589.5		21.2	74%	350°C	360°C	2.0%
18:45	90.0	2636.4	2.2	76590.0	1.5	21.2	74	345	355	2.0
19:00	90.0	2638.6	2.2	76592.5	1.5	21.2	74	330	340	2.2
19:15	90.0	2640.9	2.3	76594.0	1.5	21.2	74	330	340	2.0
19:30	90.0	2643.2	2.3	76595.5	1.5	21.4	76	330	340	2.0
19:45	90.0	2645.4	2.2	76597.0	1.5	21.6	76	340	350	2.0
20:00	90.0	2647.6	2.2	76598.5	1.5	21.6	75	340	350	2.2
20:15	90.0	2649.9	2.3	76600.0	1.5	21.6	75	340	350	1.8
20:30	90.0	2652.1	2.2	76601.4	1.4	21.2	75	350	355	2.0
20:45	90.0	2654.4	2.3	76602.8	1.4	21.4	75	350	355	2.0
21:00	90.0	2656.7	2.3	76604.2	1.4	21.4	75	355	360	2.0

TABLE 3. UNIT 5 PRODUCTION DURING TEST 3.

TIME	TURBINE LOAD					STEAM FLOW FT. H₂O	RELATIVE AIR FLOW	AIRHEATER OUTLET TEMPS		O₂
	INDICATED *	INTEGRATED	DIFFERENCE	UNIT TRANSFORMER	DIFFERENCE			A	B	
09:45	87.0	2765.2		76680.2		20.8	72%	330°C	340°C	2.1%
10:00	87.0	2767.2	2.0	76681.2	1.2	21.0	72	325	335	1.9
10:15	88.0	2769.3	2.1	76682.6	1.4	21.2	73	330	340	2.1
10:30	87.0	2771.5	2.2	76683.9	1.3	21.0	73	330	340	2.2
10:45	87.0	2773.7	2.2	76685.2	1.3	21.0	74	335	340	2.0
11:00	87.0	2775.9	2.2	76686.6	1.4	20.8	74	340	340	2.1
11:15	87.0	2778.0	2.1	76887.9	1.3	20.8	74	340	350	2.0
11:30	87.0	2780.0	2.0	76689.1	1.2	20.6	74	340	350	2.2
11:45	86.0	2782.1	2.1	76690.4	1.3	20.4	74	345	352	2.2
12:00	88.0	2784.3	2.2	76691.5	1.1	20.5	75	348	355	2.0

* Megawatts

TABLE 4. UNIT 5 PRODUCTION DURING TEST 4

Time	UNIT LOAD					TURBINE S.V. Steam		AIRHEATER Outlet		DUST COLLECTOR				O_2	Rel. Steam Flow	Rel. Air Flow	Scotblowing Steam Flow
	MW Ind.	Integ. MWH	Diff. MWH	Unit Trans.	Diff.					Inlet		Outlet					
	MW	+10	+10	MWH	MWH	Press. MPa	Temp. °C	A °F	B °F	A KPa	B KPa	A KPa	B KPa	%	%	%	K lbs./hr.
10:15	86	06773.9		79113.5		8.50	542	360	360	1.70	1.80	2.20	2.30	3.5	86	92	4.5
10:30	85	06776.0	2.1	79114.8	1.3	8.40	542	360	360	1.70	1.80	2.20	2.30	2.8	87	92	4.5
10:45	85	06778.1	2.1	79116.0	1.2	8.50	542	350	350	1.70	1.80	2.25	2.30	3.2	87	92	4.6
11:00	85	06780.2	2.1	79117.2	1.2	8.50	542	350	360	1.70	1.80	2.30	2.30	3.2	88	92	4.8
11:15	85	06782.3	2.1	79118.5	1.3	8.50	542	350	360	1.70	1.80	2.30	2.35	3.1	88	92	4.8
11:30	85	06784.3	2.0	79119.9	1.4	8.50	540	350	360	1.70	1.80	2.30	2.35	3.1	88	92	4.3
11:45	86	06786.4	2.1	79121.0	1.1	8.62	542	340	350	1.70	1.80	2.30	2.35	3.2	89	91	5.0
12:00	86	06788.5	2.1	79122.2	1.2	8.55	538	325	335	1.70	1.80	2.20	2.30	3.5	89	91	3.2
12:15	86	06790.6	2.1	79123.8	1.6	8.50	538	320	320	1.70	1.80	2.20	2.30	3.5	88	91	3.2

TEST 5. UNIT 5. PRODUCTION DURING TEST 5.

Time	UNIT LOAD					TURBINE S.V. Steam		AIRHEATER Outlet		DUST COLLECTOR				O_2	Rel. Steam Flow	Rel. Air Flow	Soothblowing Steam Flow
		Integ.	Diff.							Inlet		Outlet					
	MW Ind.	MWH	MWH	Unit Trans.	Diff.	Press.	Temp.	A	B	A	B	A	B				
	MW	±10	±10	MWH	MWH	MPa	°C	°F	°F	KPa	KPa	KPa	KPa	%	%	%	K lbs./hr.
12:30	86	06792.8	2.2	79124.8	1.0	8.62	538	320	325	1.70	1.80	2.20	2.30	2.6	89	91	0
12:45	87	06795.0	2.0	79126.1	1.3	8.60	538	320	325	1.70	1.80	2.15	2.25	3.1	88	91	3.0
13:00	87	06797.0	2.0	79127.2	1.1	8.62	538	320	325	1.70	1.80	2.20	2.30	3.3	88	91	3.0
13:15	87	06799.1	2.1	79128.6	1.4	8.55	542	320	325	1.75	1.85	2.25	2.35	3.3	88	91	4.5
13:30	87	06801.2	2.1	79129.8	1.2	8.62	542	320	325	1.75	1.85	2.25	2.35	3.3	88	91	4.5
13:45	87	06803.4	2.2	79130.9	1.1	8.55	540	320	325	1.70	1.80	2.20	2.30	3.6	88	91	4.8
14:00	87	06805.5	2.1	79132.1	1.2	8.52	538	320	325	1.70	1.80	2.25	2.35	4.2	88	91	4.2
14:15	87	06807.6	2.1	79133.2	1.1	8.50	538	320	325	1.75	1.85	2.25	2.35	3.2	87	91	0
14:30	87	06809.7	2.1	79134.8	1.4	8.45	538	320	325	1.70	1.80	2.20	2.25	2.8	85	91	5.0
14:45	87	06811.9	2.2	79135.8	1.2	8.50	540	320	325	1.70	1.80	2.20	2.30	2.8	88	91	4.0
15:00	87	06814.0	2.1	79137.1	1.3	8.45	539	320	325	1.70	1.80	2.20	2.30	2.7	87	90	6.0
15:15	87	06816.0	2.0	79138.5	1.4	8.50	538	320	325	1.70	1.80	2.20	2.30	3.1	88	90	3.5

TABLE 6. UNIT 5. PRODUCTION DURING TEST 6.

Time	UNIT LOAD					TURBINE		AIRHEATER Outlet		DUST COLLECTOR				O_2	Rel. Steam Flow	Rel. Air Flow	Soothblowing Steam Flow
	MW Ind.	Integ. MWH #10	Diff. MWH #10	Unit Trans. MWH	Diff. MWH	B.V. Steam Press.	B.V. Steam Temp.	A	B	Inlet A	Inlet B	Outlet A	Outlet B				
	MW	#10		MWH	MWH	MPa	°C	°F	°F	KPa	KPa	KPa	KPa	%	%	%	K lbs./hr.
15:30	87	06818.1	2.1	79139.6	1.1	8.50	538	320	325	1.70	1.80	2.20	2.30	3.0	88	90	3.2
15:45	87	06810.2	2.1	79140.9	1.3	8.55	538	320	325	1.65	1.75	2.15	2.25	3.0	87	90	0
16:00	87	06822.4	2.2	79142.2	1.3	8.55	538	320	325	1.65	1.75	2.15	2.25	3.2	88	90	5.0
16:15	87	06824.5	2.1	79143.4	1.2	8.55	538	320	325	1.65	1.75	2.15	2.25	3.0	88	90	0
16:30	87	06826.6	2.1	79144.8	1.6	8.55	538	320	325	1.75	1.85	2.25	2.35	3.0	88	90	4.5

TEST PROCEDURES

Sampling for tests 1 through 3 was conducted from seven ports located diagonally on the north face of the 91 inches by 100 inches rectangular Unit 5B Breeching (see Figure 2 Top View of Unit 5). The sampling locations were 12 inches (0.1 diameter equivalents) downstream from a damper and 108 inches (1.1 diameter equivalents) upstream from a change of direction (see Figure 3 Front View of Unit 5B Breeching). Eight points were sampled along each traverse. The sample points, located at 6.25, 18.75, 31.25, 43.75, 56.25, 68.75, 81.25 and 93.75 inches respectively from the breeching wall are depicted in a cross section of the breeching in Figure 4. Sampling intervals were two minutes per point.

Sampling for tests 4 through 6 was conducted from four ports located along the same plane as previously sampled in tests 1 through 3. Four points were sampled along each traverse. The sample points, located at 12.5, 37.5, 62.5 and 87.5 inches respectively from the breeching wall are depicted in a cross section of the breeching in Figure 5. Sampling intervals were three minutes per point.

Source emission testing was conducted according to EPS Method E. Figure 6 illustrates the particulate stack sampling train. The sample was drawn into a 0.185 inch nozzle, through a 10 foot stainless steel heated probe and into a miniature cyclone which removed particulate matter of greater than 10μ diameter. The sample was then passed through a Whatman 934 AH glass microfiber filter (supported by a porous fritted glass disc), which removed particulate

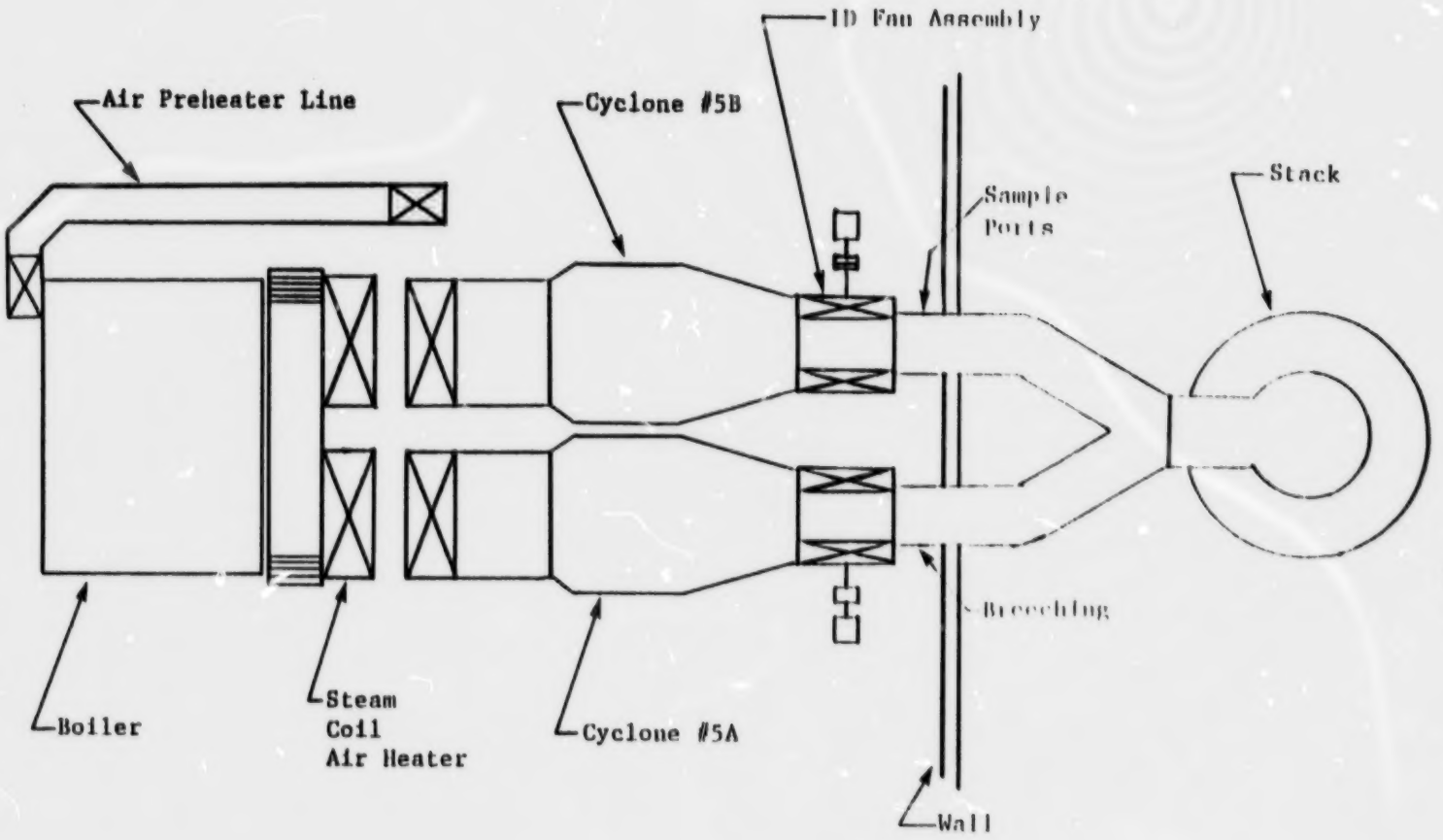


FIGURE 2. TOP VIEW OF UNIT 5.

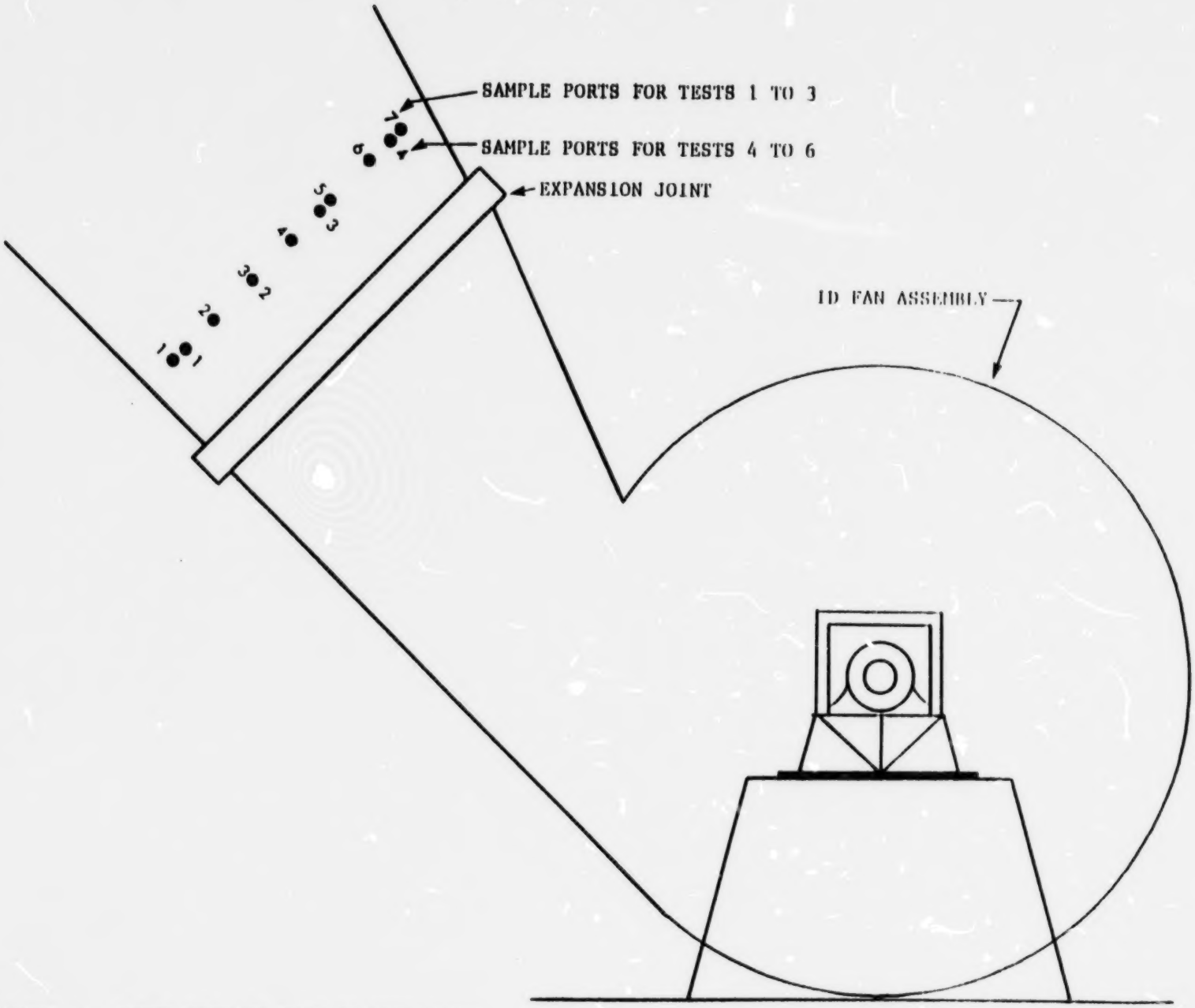


FIGURE 3. FRONT VIEW OF UNIT 5B BREECHING.

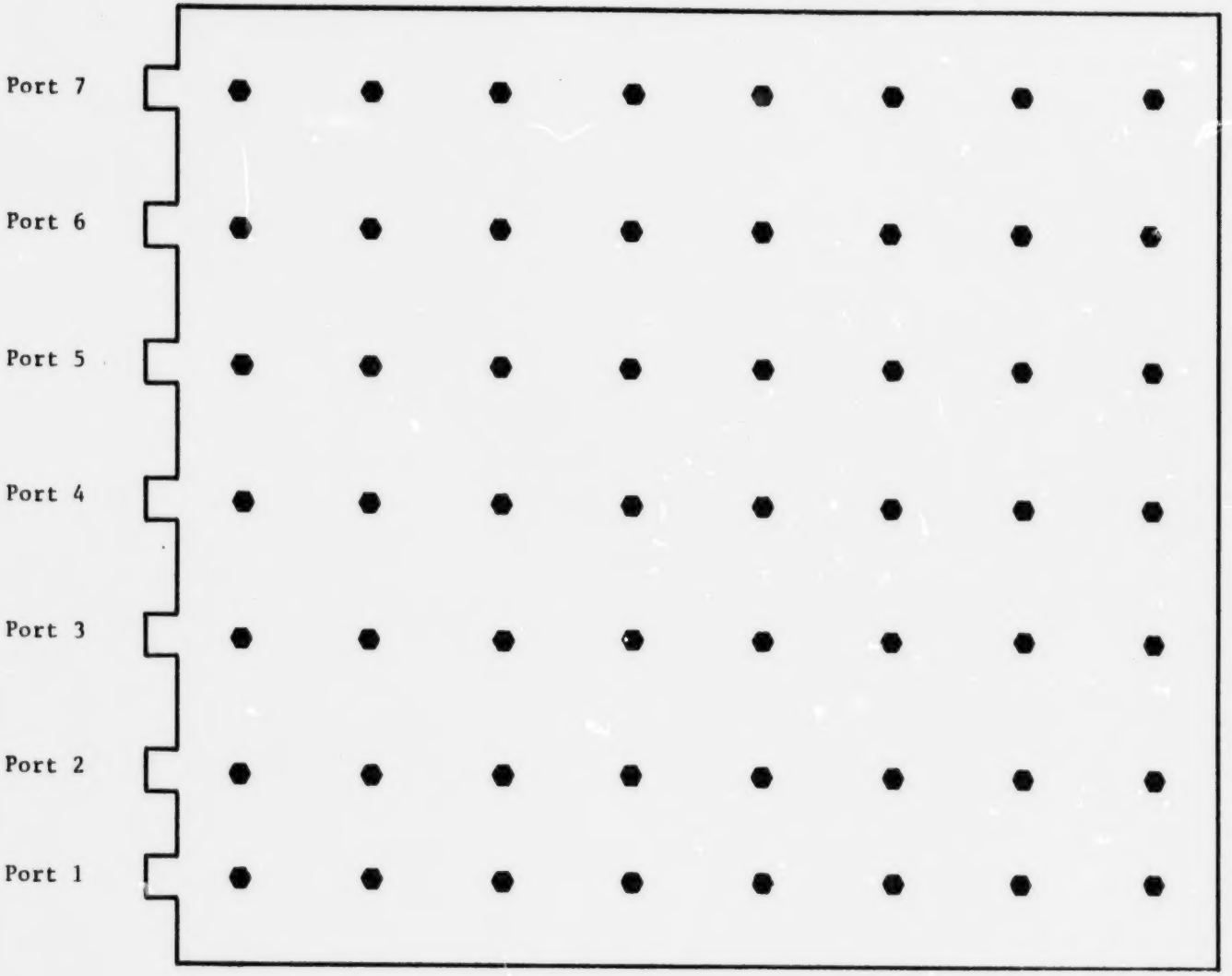


FIGURE 4. CROSS SECTION OF UNIT 5B BREECHING DEPICTING SAMPLE POINT LOCATIONS FOR TESTS 1 TO 3.

(● = SAMPLE POINT LOCATION)

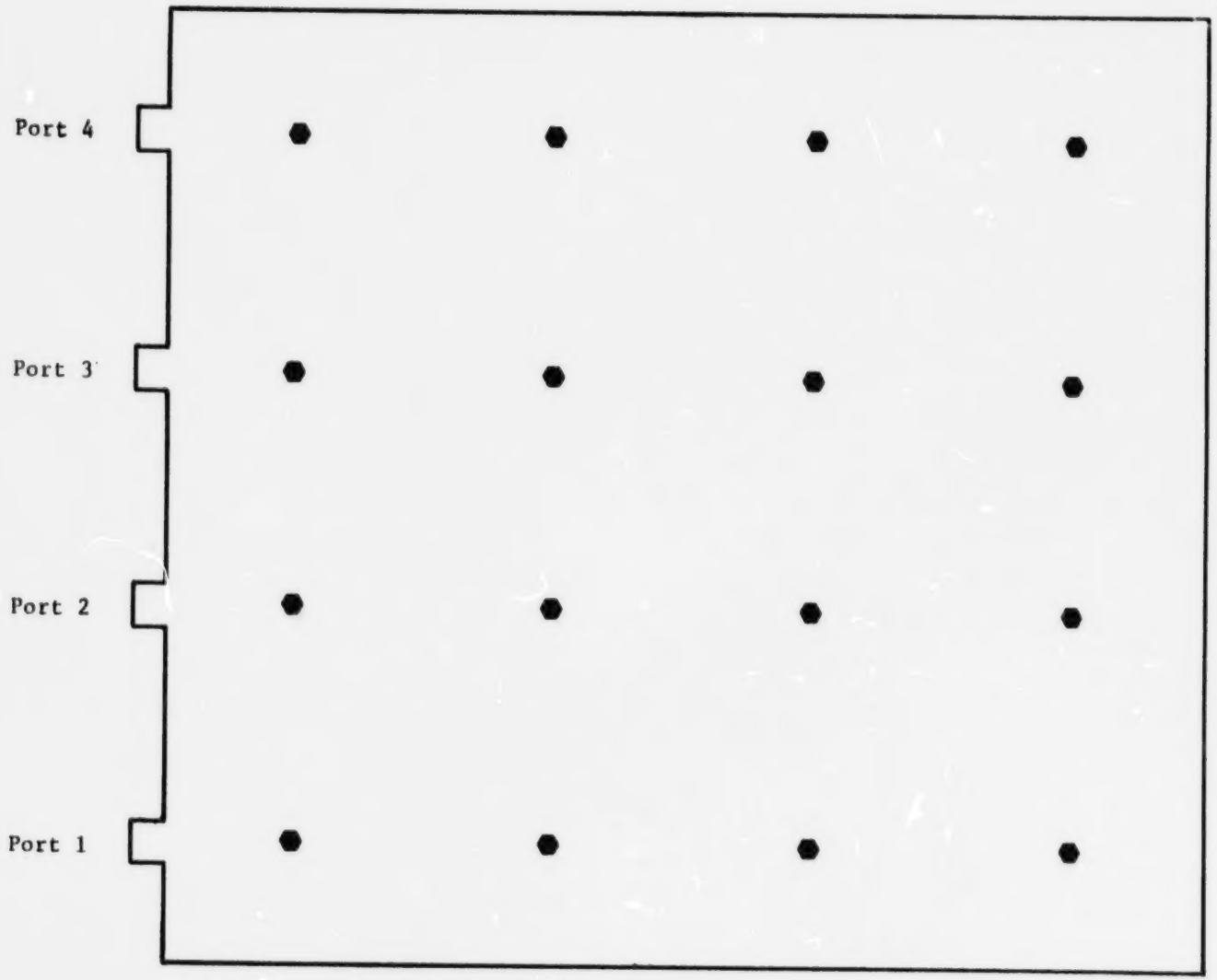


FIGURE 5. CROSS SECTION OF UNIT 5B BREECHING DEPICTING SAMPLE POINT LOCATIONS FOR TESTS 4 TO 6.

(● = SAMPLE POINT LOCATION)

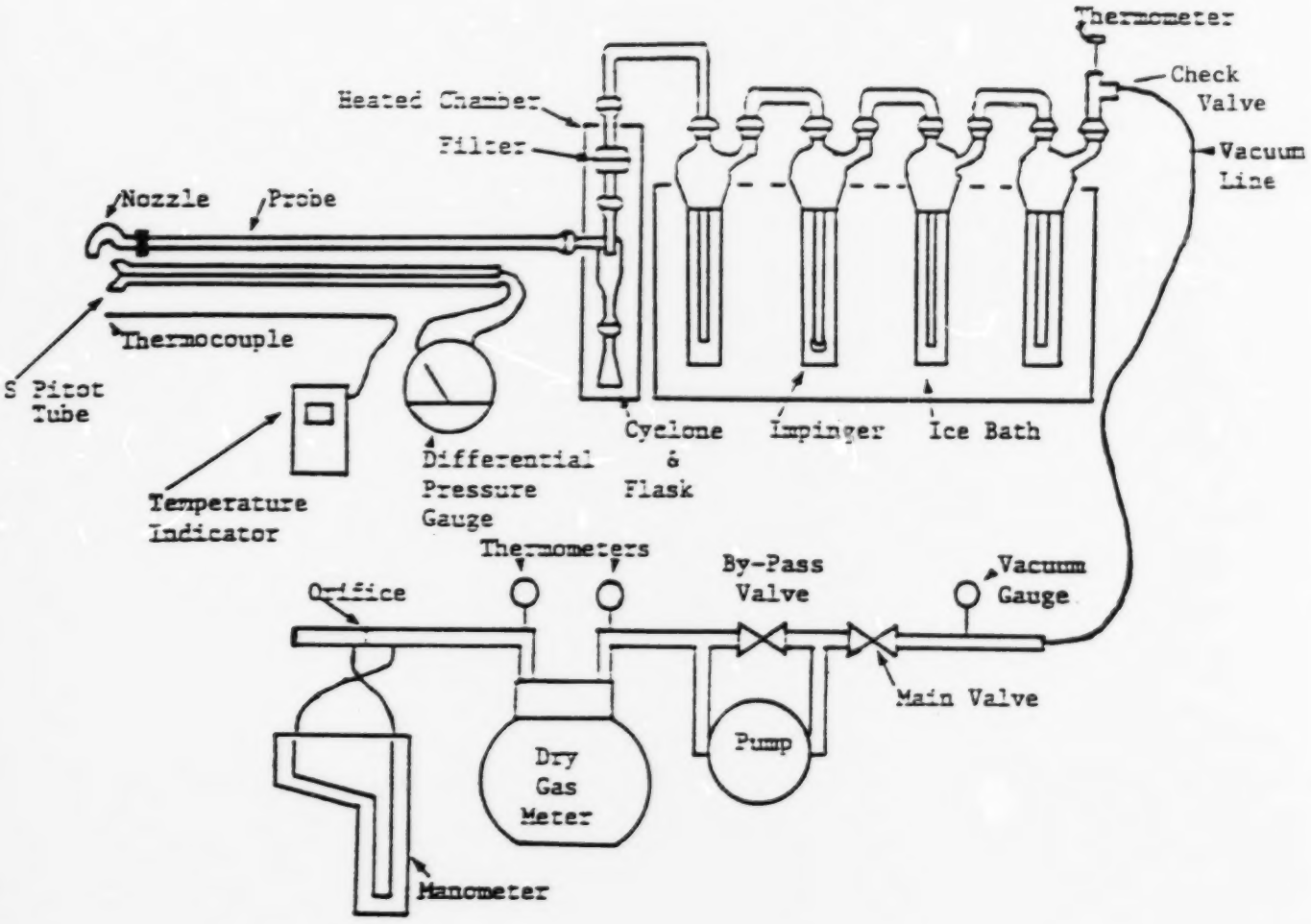


FIGURE 6. PARTICULATE STACK SAMPLING TRAIN.

matter of 0.3μ diameter and greater. Both the cyclone and the filter were heated to prevent moisture from condensing on the glassware. The sample was then passed through four 500 ml Greenburg-Smith impingers connected in series in an ice bath. The first, third and fourth impingers had modified straight tips while the second was of the standard design. The first and second impingers contained 100 ml of deionized water. The third impinger was initially empty while the fourth contained 200 grams of indicating silica gel to remove remaining moisture from the gas sample.

A Bendix Series 4500 Isokinetic Stack Sampler was used to extract the samples from the stack. Gas velocity in the stack was measured with an S type pitot tube and a Dwyer Magnehelic Differential Pressure Gauge (range 0 to 2.0" H_2O, minor division 0.05" H_2O). Dry gas meter and pitot tube calibration data sheets are located in Appendix A. A Hays-Republic Model 621A Gas Analyzer was used to determine CO_2, O_2 and CO content of the stack gas. Stack temperature was measured by a K type thermocouple.

After sample recovery from the stack train, samples were submitted to the W. M. Ward Technical Services Laboratory for gravimetric analyses of particulates.

The sampling team consisted of Kevin Reeve, Art Schultz and Barry Cowan.

RESULTS

Important sampling parameters are summarized in Table 7. Refer to Appendices B and C respectively for velocity profiles and field data sheets.

Source emission data are summarized in Table 8. The particulate analytical reports are located in Appendix D.

TABLE 7: SUMMARY OF SAMPLING PARAMETERS

TEST NUMBER	1	2	3
SAMPLING DATE	Jan. 7/86	Jan. 7/86	Jan. 8/86
SAMPLING DURATION, min.	112	112	112
SAMPLE VOLUME AT METER CONDITIONS, m^3	1.3279	1.2174	1.2737
SAMPLE VOLUME AT STANDARD CONDITIONS, dscm*	1.2617	1.1553	1.1986
AVERAGE GAS METER TEMPERATURE, °C	33	32	30
ORIFICE PRESSURE DROP, mm H_2O	18.49	14.58	14.86
BREECHING STATIC PRESSURE, mm H_2O	-3.81	-3.81	-3.81
AVERAGE BREECHING TEMPERATURE, °C	176	167	165
AVERAGE BREECHING VELOCITY, m/s	17.4	17.0	17.6
ISOKINETIC FACTOR, %	103.6	100.6	102.4

*Standard Conditions are 25°C and 760 mm Hg

TABLE 7: (CONTINUED)

TEST NUMBER	4	5	6
SAMPLING DATE	April 3/86	April 3/86	April 3/86
SAMPLING DURATION, min.	48	48	48
SAMPLE VOLUME AT METER CONDITIONS, m^3	0.5052	0.4711	0.4627
SAMPLE VOLUME AT STANDARD CONDITIONS, dscm*	0.4796	0.4458	0.4349
AVERAGE GAS METER TEMPERATURE, °C	32	33	35
ORIFICE PRESSURE DROP, mm H_2O	14.07	12.65	11.81
BREECHING STATIC PRESSURE, mm H_2O	-3.73	-3.73	3.73
AVERAGE BREECHING TEMPERATURE, °C	177	161	156
AVERAGE BREECHING VELOCITY, m/s	17.5	16.1	15.5
ISOKINETIC FACTOR, %	99.5	95.5	95.5

*Standard Conditions are 25°C and 760 mm Hg

TABLE 8: SOURCE EMISSION SUMMARY

TEST NUMBER		1	2	3	AVERAGE
STACK GAS COMPOSITION DRY BASIS, % BY VOLUME	CO_2	15.1	14.9	13.3	
	O_2	7.1	4.9	6.0	
STACK GAS MOISTURE, % BY VOLUME		12.4	13.0	13.4	
Ms**, g/g-mole		29.13	28.94	28.71	
AVERAGE VOLUMETRIC FLOW RATE OF BREECHING 5B, dscm/h		206,439	203,615	208,668	206,241
CONCENTRATION OF PARTICULATE IN BREECHING 5B, g/dscm:	AT STACK CO_2	6.06	2.70	4.98	4.58
	AT 12% CO_2	4.82	2.17	4.49	3.83
PARTICULATE EMISSION RATE OF BREECHING 5B, kg/h		1251	550	1039	947

** Molecular Weight of the Stack Gas on a Wet Basis

TABLE 8: (CONTINUED)

TEST NUMBER		4	5	6	AVERAGE
STACK GAS COMPOSITION DRY BASIS, % BY VOLUME	CO_2	17.5	16.0	16.5	
	O_2	4.0	3.5	3.5	
STACK GAS MOISTURE, % BY VOLUME		16.1	16.0	15.6	
Ms**, g/g-mole		28.87	28.67	28.79	
AVERAGE VOLUMETRIC FLOW RATE OF BREECHING 5B, dscm/h		197,488	188,660	183,555	189,901
CONCENTRATION OF PARTICULATE IN BREECHING 5B, g/dscm:	AT STACK CO_2	2.95	2.85	2.48	2.76
	AT 12% CO_2	2.02	2.14	1.80	1.99
PARTICULATE EMISSION RATE OF BREECHING 5B, kg/h		583	538	455	525

** Molecular Weight of the Stack Gas on a Wet Basis

DISCUSSION

Fly ash released from coal fired boilers may be either partially oxidized organic matter or noncombustible inorganic contaminants in the fuel. Other contaminants, such as sulfur, are released mainly as gaseous oxides and hence are not collected during a particulate test. In thermal plants where no particulate control devices were installed approximately 80 percent of the fly ash was entrained in the flue gas and subsequently emitted to the atmosphere. High emission rates necessitated some form of particulate collection device.

The high concentration of particulate matter emitted from Brandon Generating station was mainly due to the dust collection system utilized. The multiclones at the Brandon plant have a typical efficiency of appproximately 70 percent. Boilers at new coal burning thermal generating stations utilize electrtostatic precipitators which have a particulate collection efficiency of approximately 99 percent.

The first three tests were not considered to be representative of normal conditions as electrical generation was increased during Test 1 and coal firing problems were encountered during Test 3. The concentration of particulate in the flue gas during Tests 1 and 3 was approximately double that of the other 4 tests.

Tests 4 to 6 were conducted under normal operating conditions.

CONCLUSION

Tests 1 to 3 indicated the average concentration of particulate matter at Unit 5, Breeching 5B was 3.83 g/dscm wnen corrected to 12 percent CO_2.

During Tests 4 to 6 the average concentration of particulate matter at Unit 5, Breeching 5B had decreased by 48 percent to 1.99 g/dscm at 12 percent CO_2.

Particulate testing indicated emissions were higher than the limit of 0.57 grams/dscm (corrected to 12% CO_2) stipulated in clause 1(c) of Clean Environment Commission Order No. 1039. However as annual electrical power generation was less than the 500,000 megawatt hours specified for the implementation of Clause 1(c), the Brandon Thermal Generating Station was not in violation of the Order.

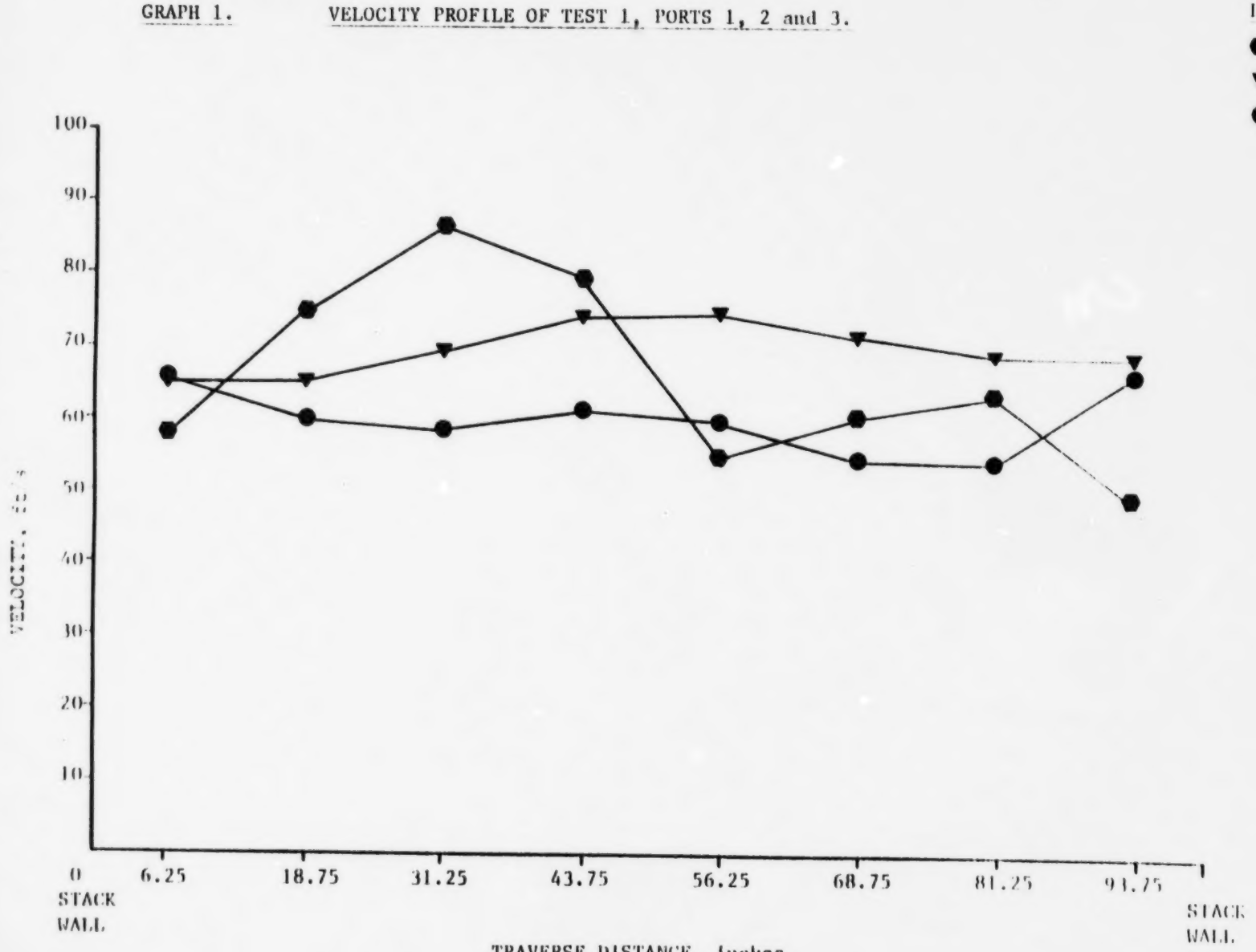
SELECTED BIBLIOGRAPHY

1. Reeve, Kevin E. Source Testing For Particulate Emissions From Power Boiler Unit 1, Selkirk Thermal Generating Station, Selkirk, Manitoba. 1986. Wpg., Mb: Manitoba Department of Environment and Workplace Safety and Health, 1987.

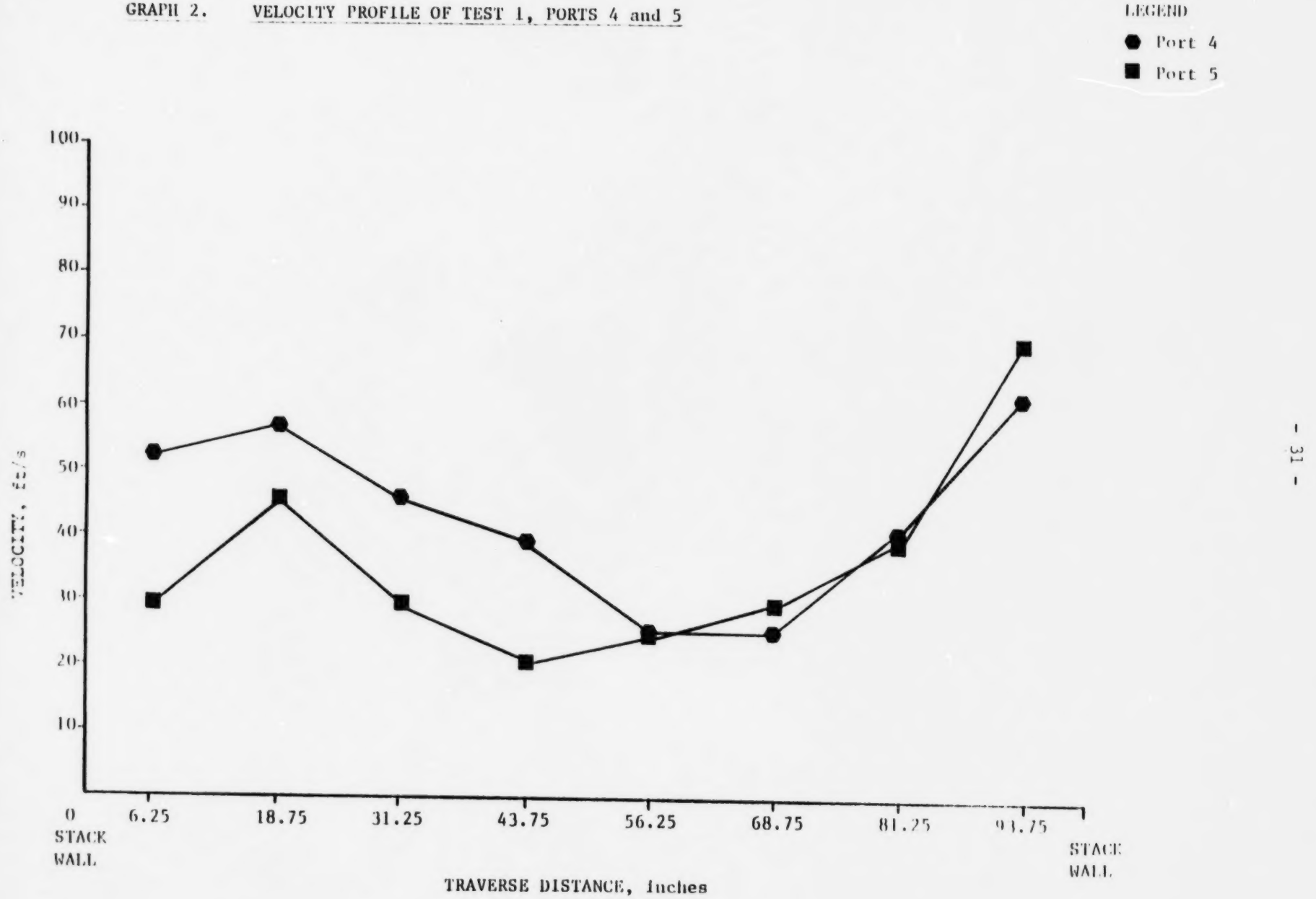
2. Standard Reference Methods For Source Testing: Measurement Of Emission Of Particulates From Stationary Sources. Ottawa, Ont: Environment Canada, Environmental Protection Service, 1974 (Report EPS 1-AP-74-1).

APPENDIX B: VELOCITY PROFILES

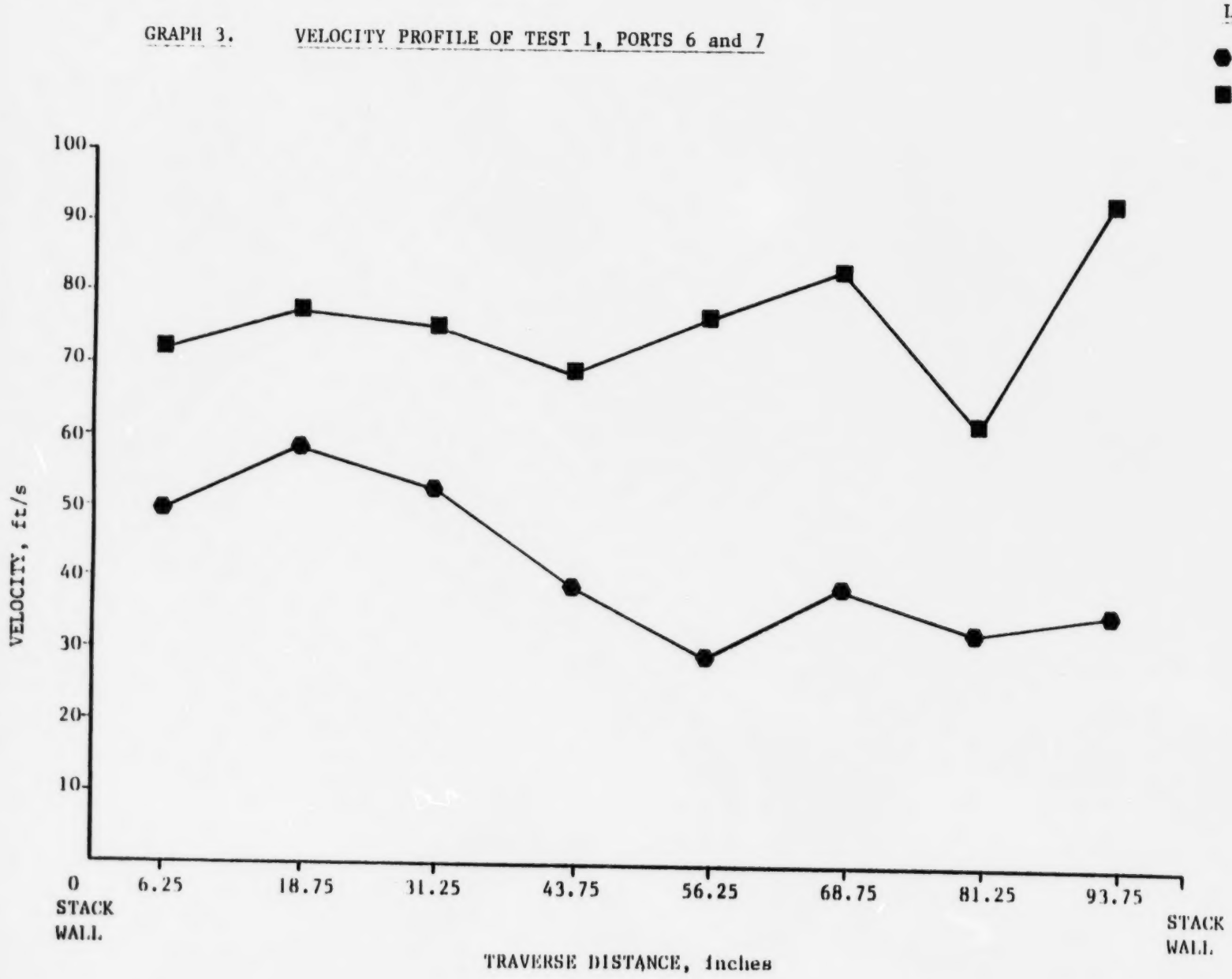
GRAPH 1. VELOCITY PROFILE OF TEST 1, PORTS 1, 2 and 3.



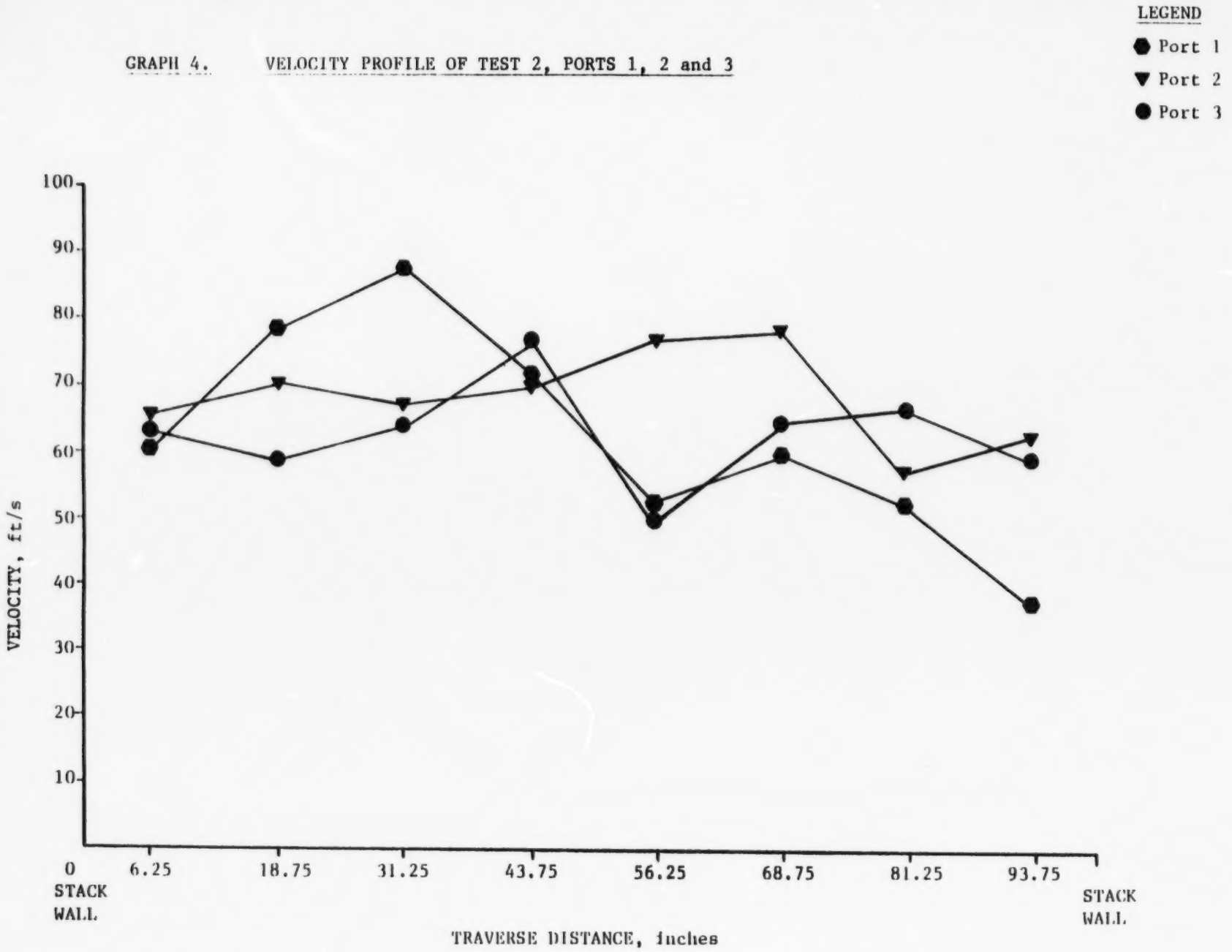
GRAPH 2. VELOCITY PROFILE OF TEST 1, PORTS 4 and 5



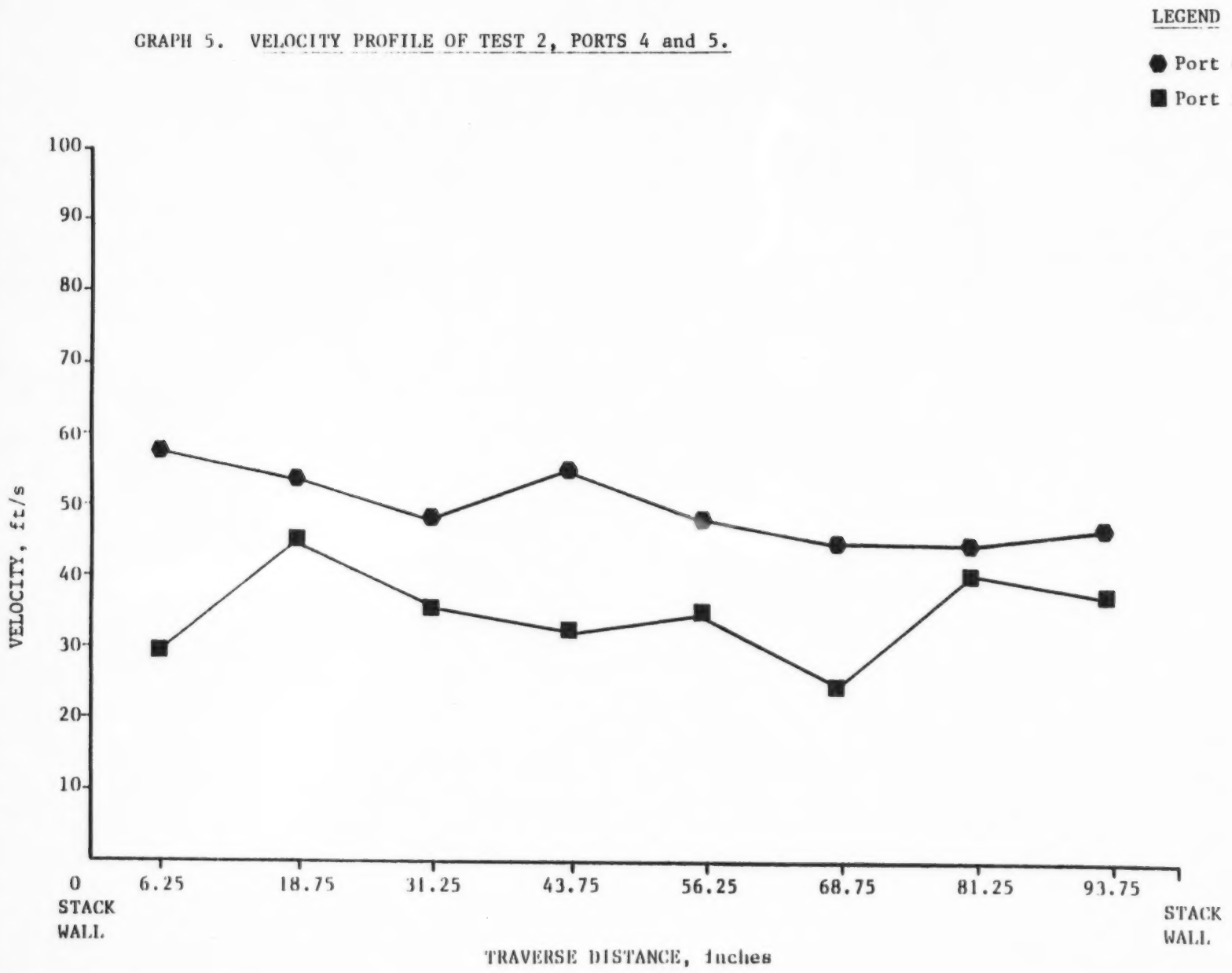
GRAPH 3. VELOCITY PROFILE OF TEST 1, PORTS 6 and 7



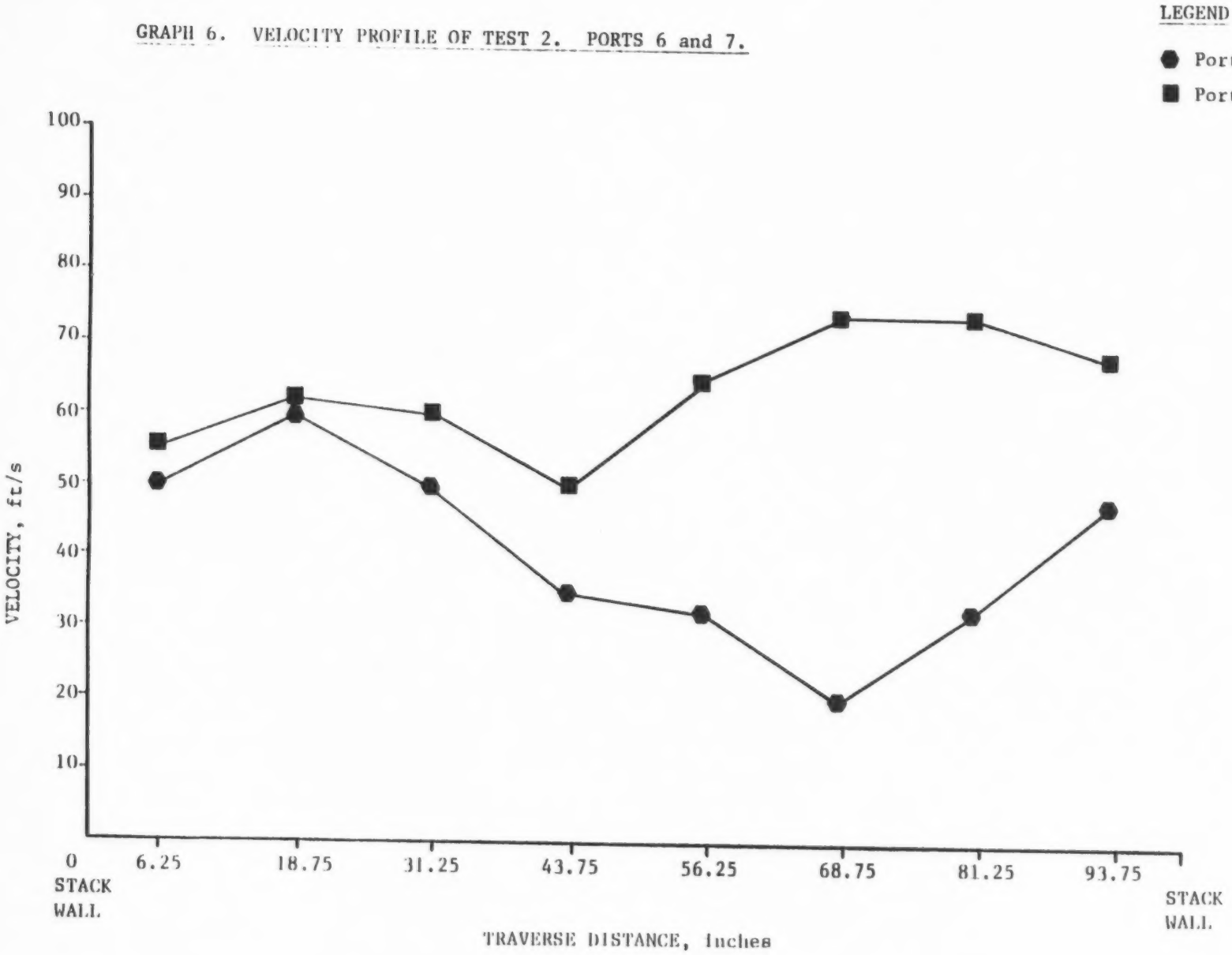
GRAPH 4. VELOCITY PROFILE OF TEST 2, PORTS 1, 2 and 3



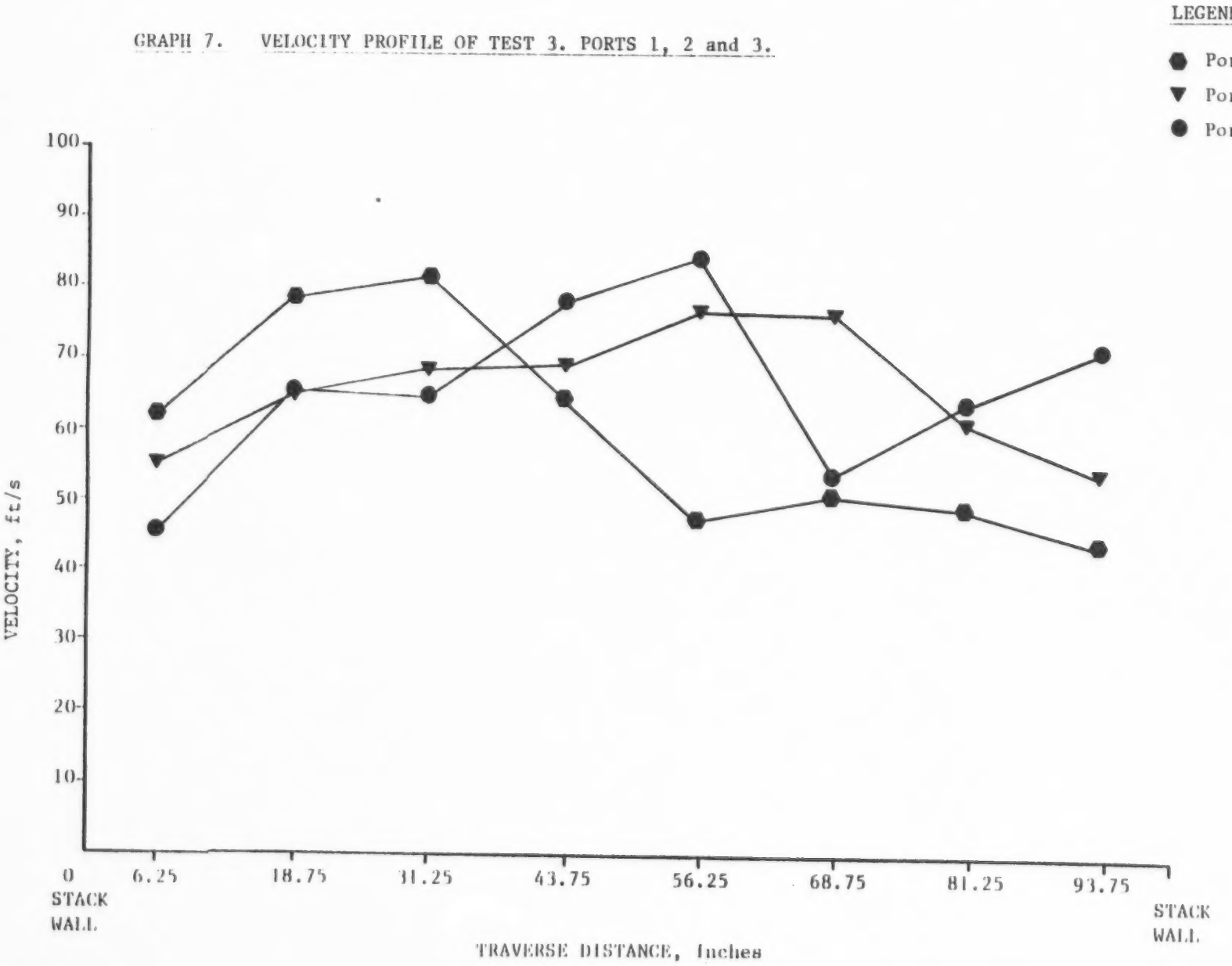
GRAPH 5. VELOCITY PROFILE OF TEST 2, PORTS 4 and 5.



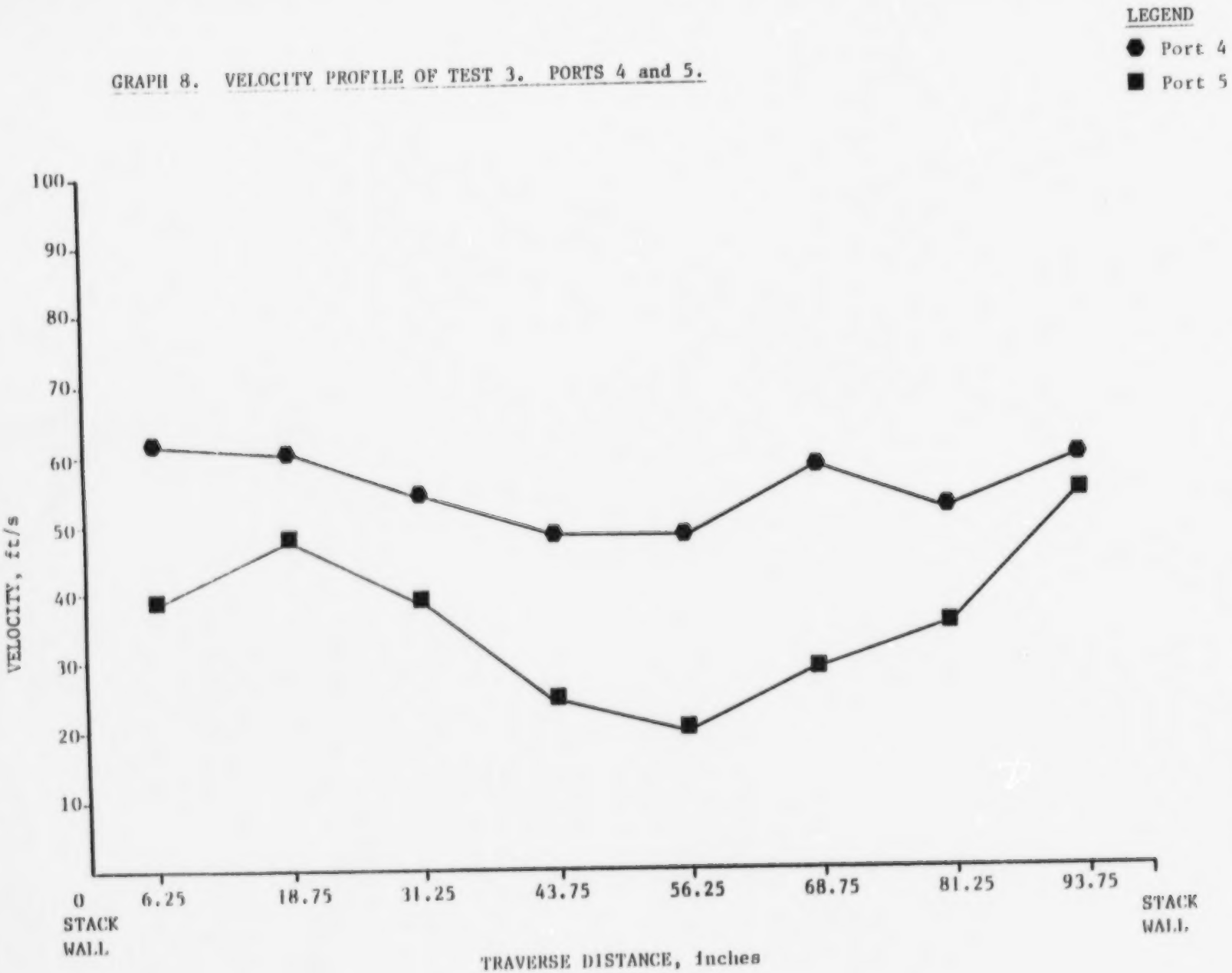
GRAPH 6. VELOCITY PROFILE OF TEST 2. PORTS 6 and 7.



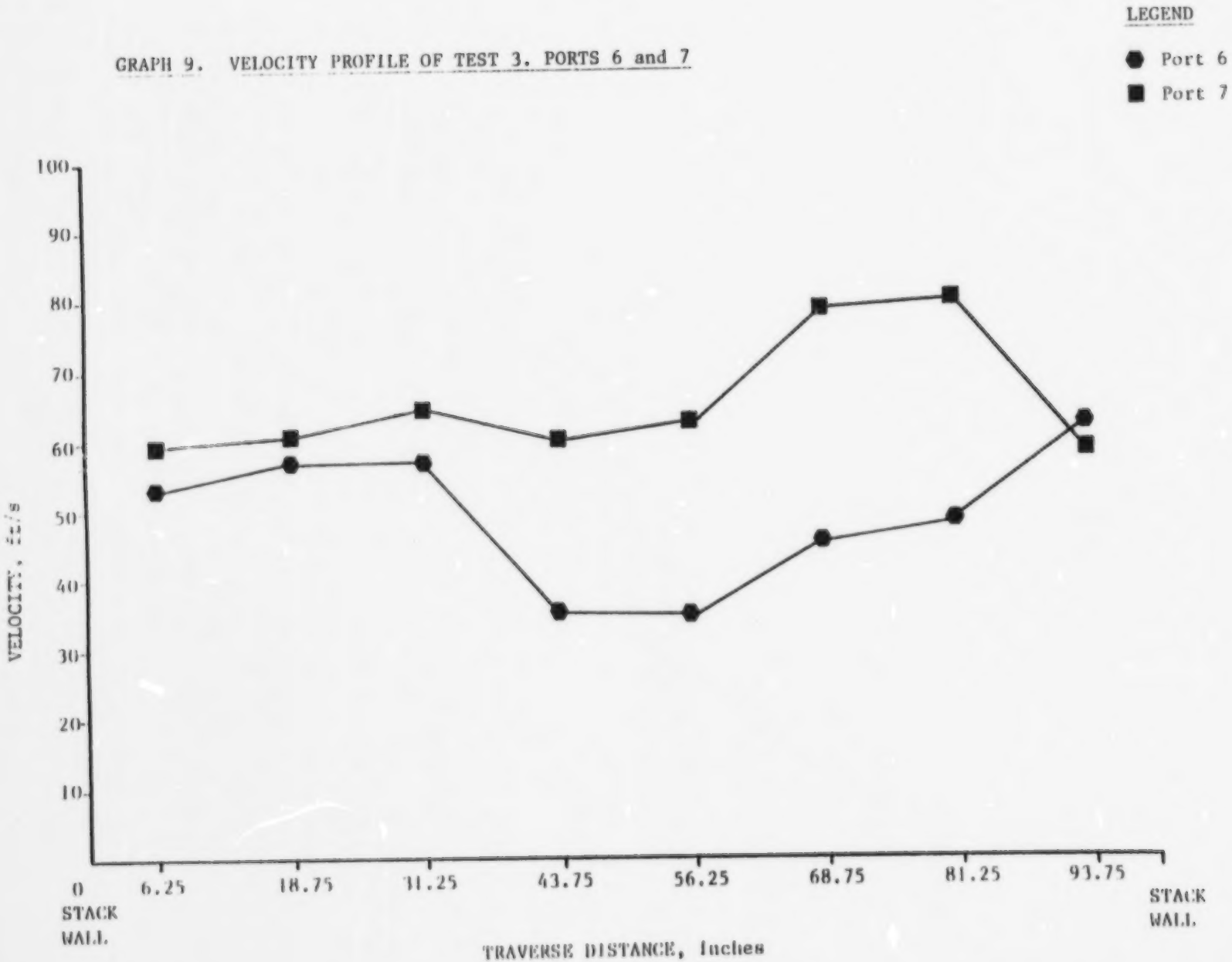
GRAPH 7. VELOCITY PROFILE OF TEST 3. PORTS 1, 2 and 3.



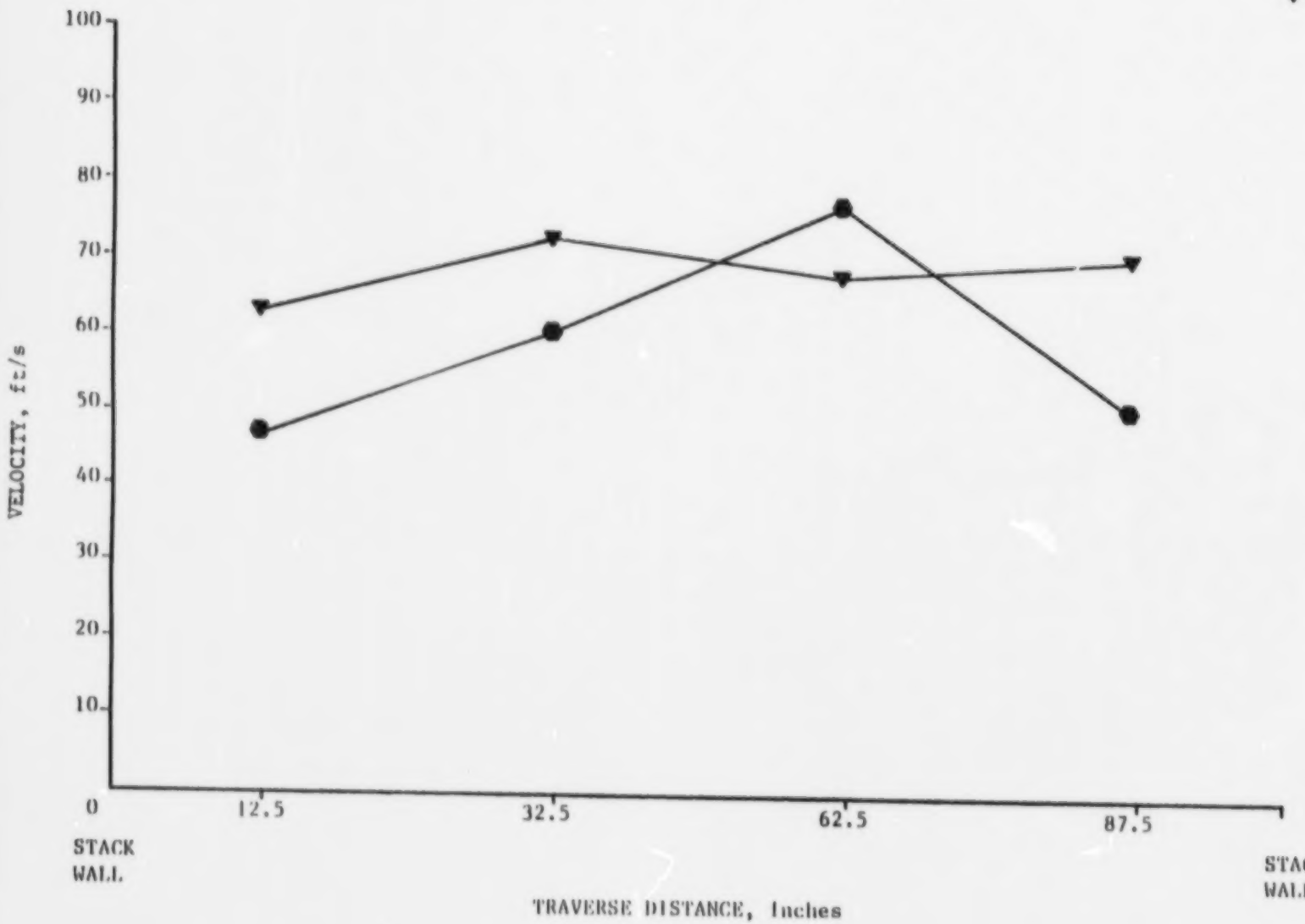
GRAPH 8. VELOCITY PROFILE OF TEST 3. PORTS 4 and 5.



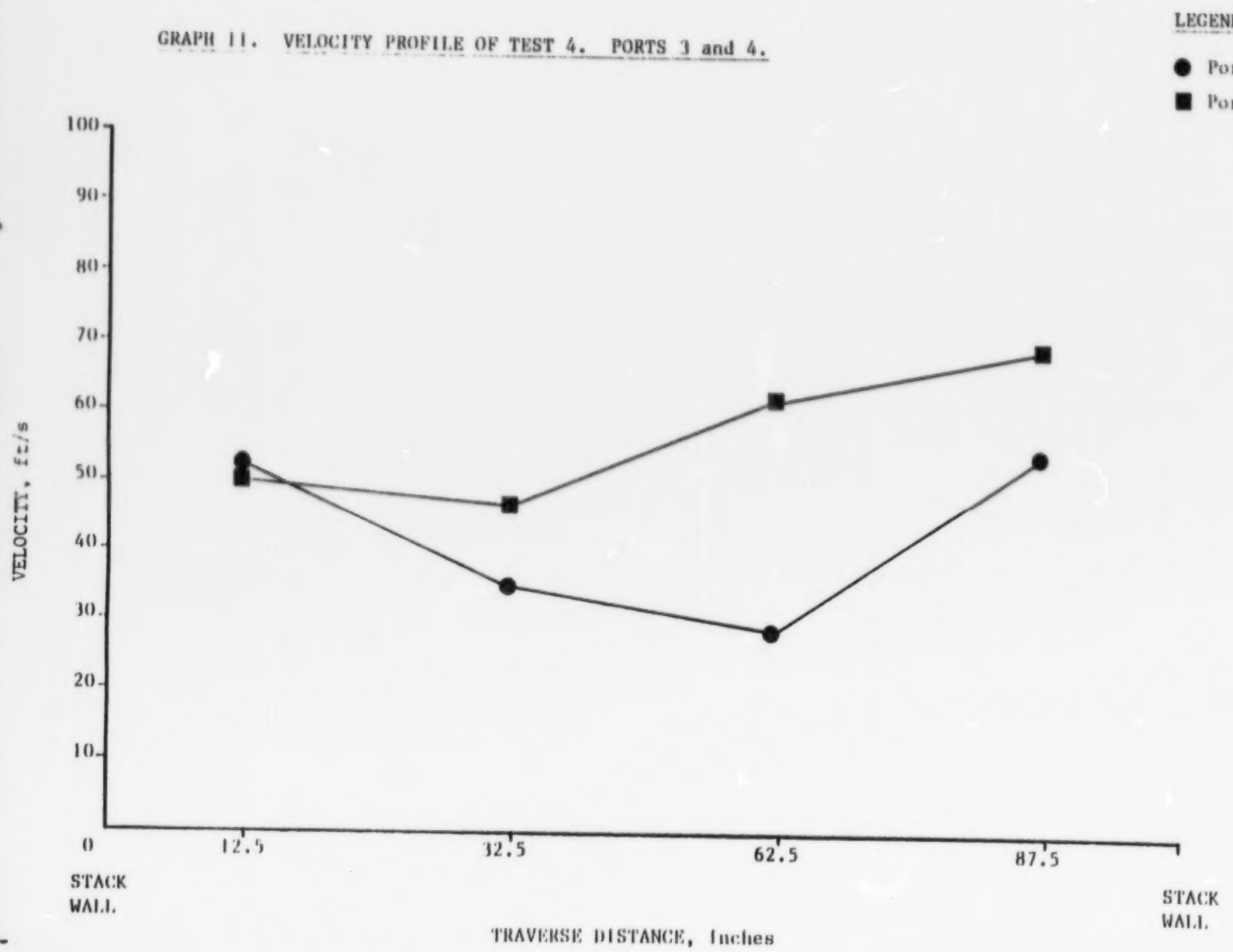
GRAPH 9. VELOCITY PROFILE OF TEST 3. PORTS 6 and 7



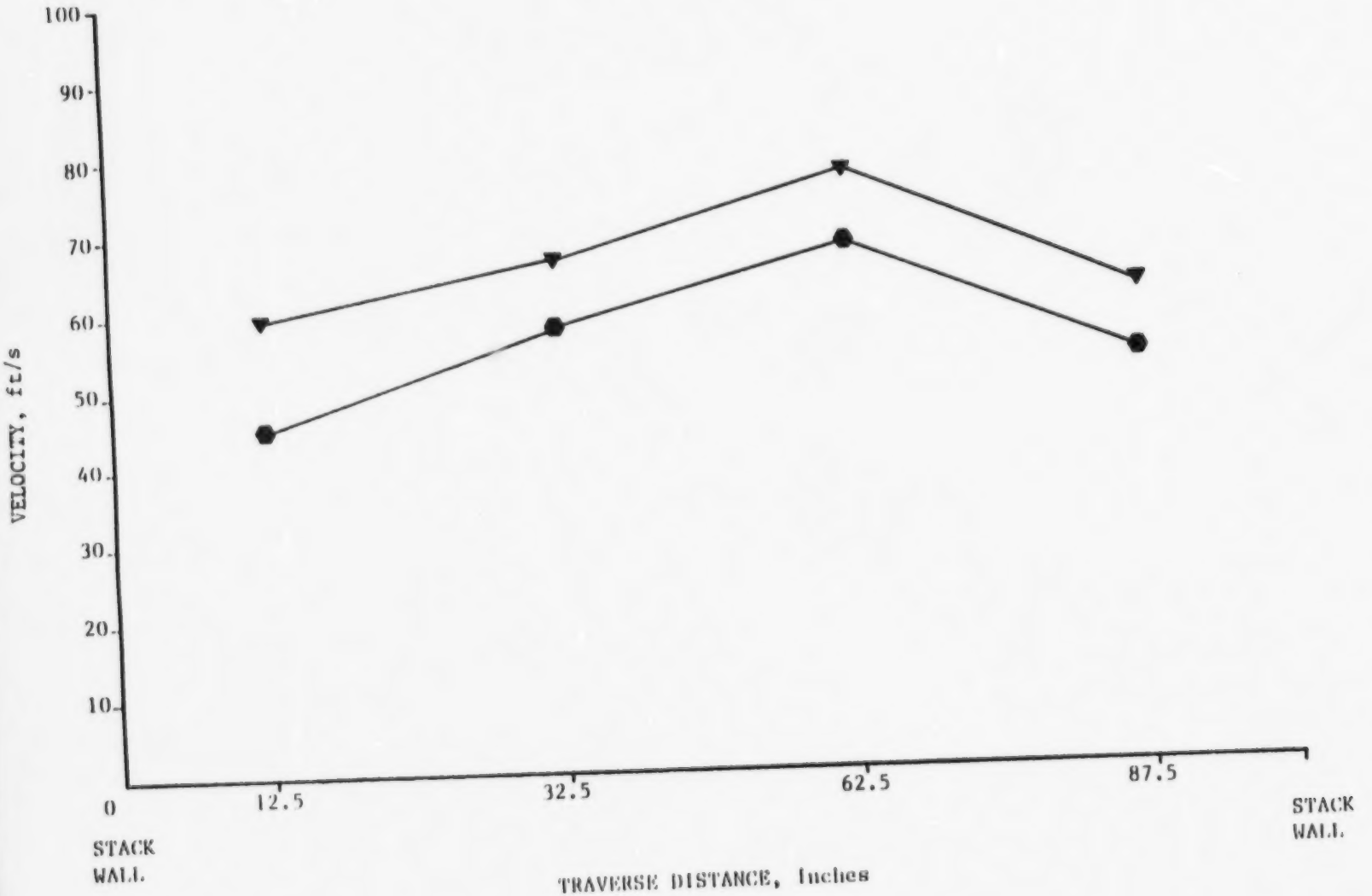
GRAPH 10. VELOCITY PROFILE OF TEST 4. PORTS 1 and 2



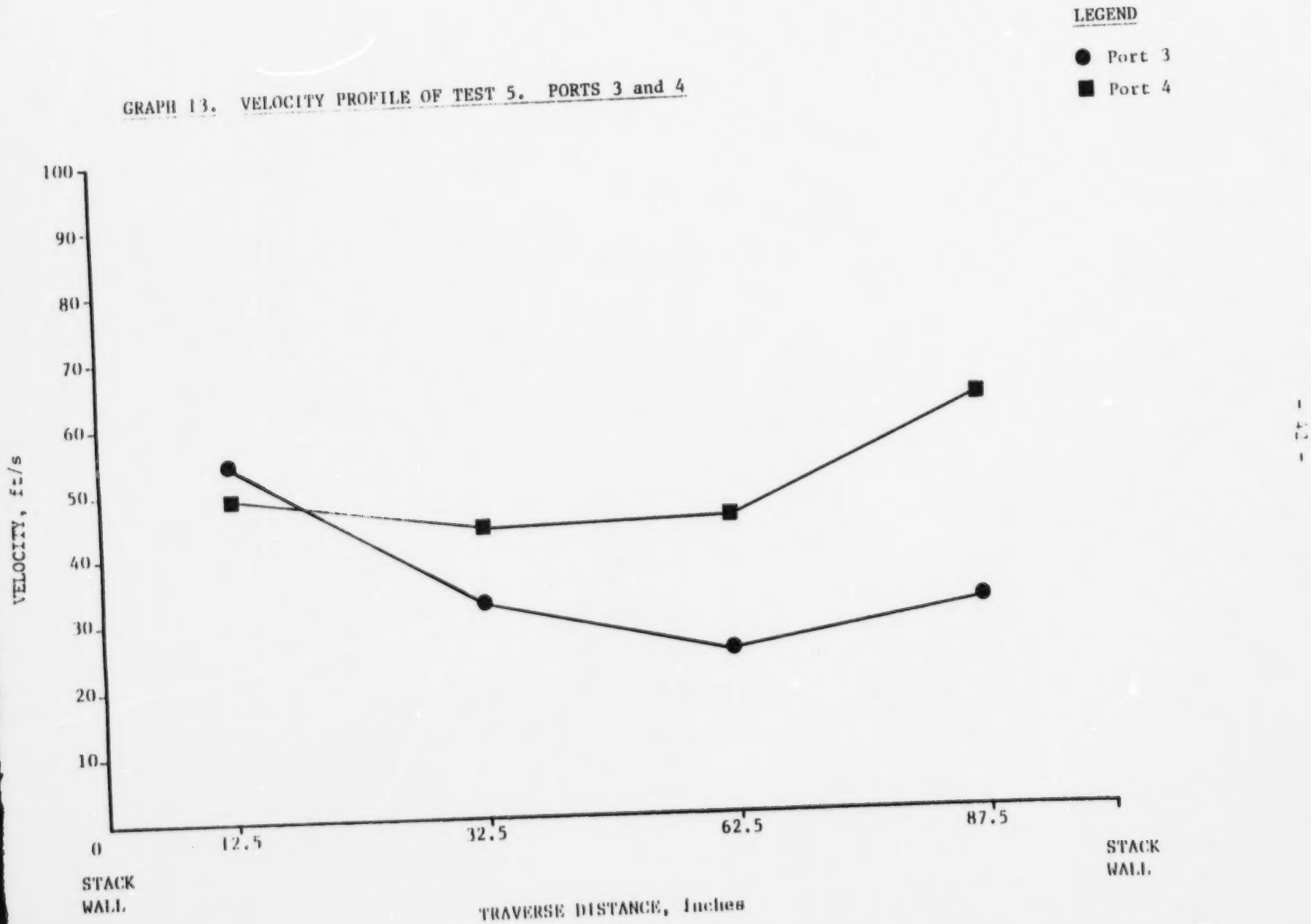
GRAPH 11. VELOCITY PROFILE OF TEST 4. PORTS 3 and 4.



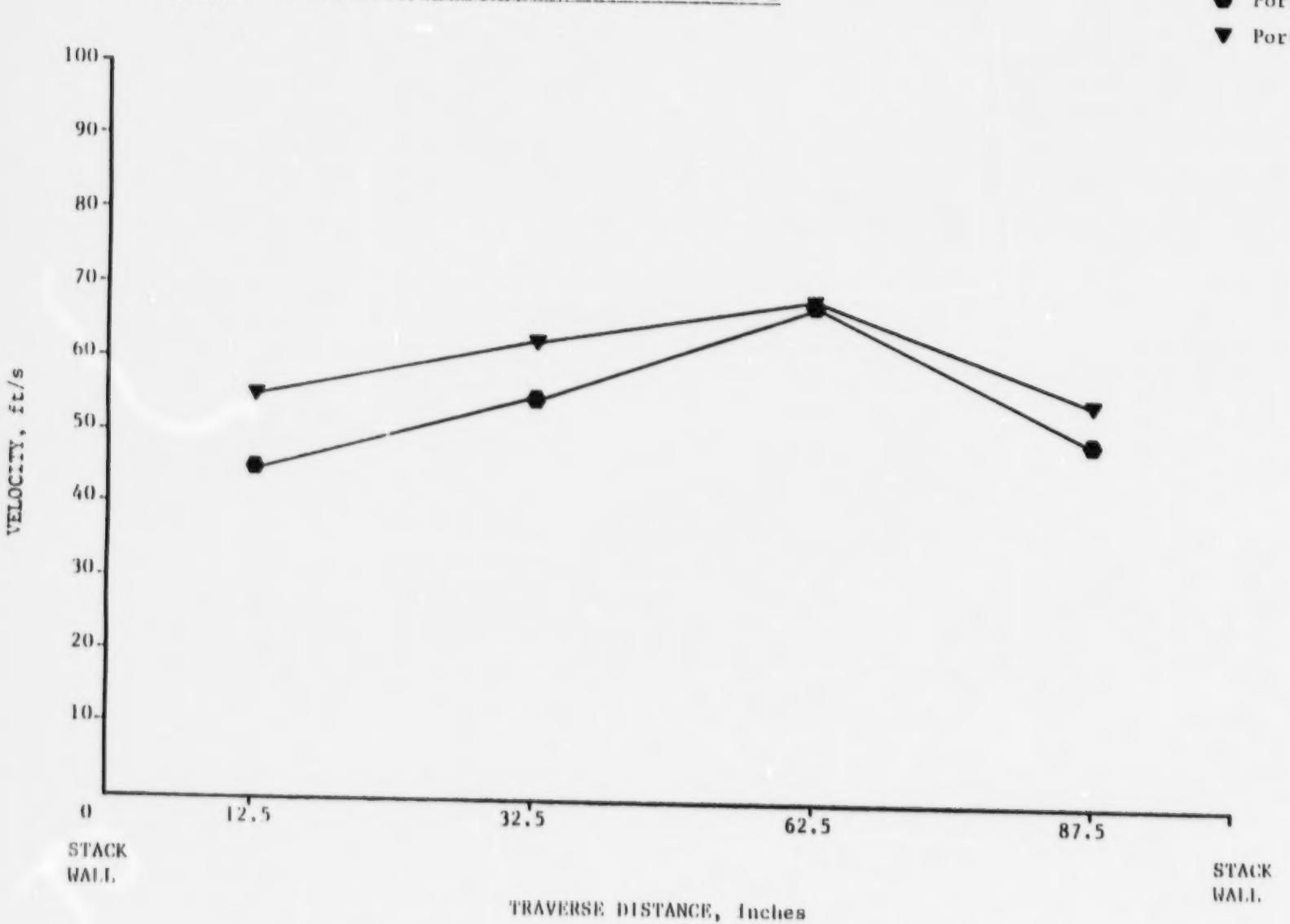
GRAPH 12. VELOCITY PROFILE OF TEST 5. PORTS 1 and 2



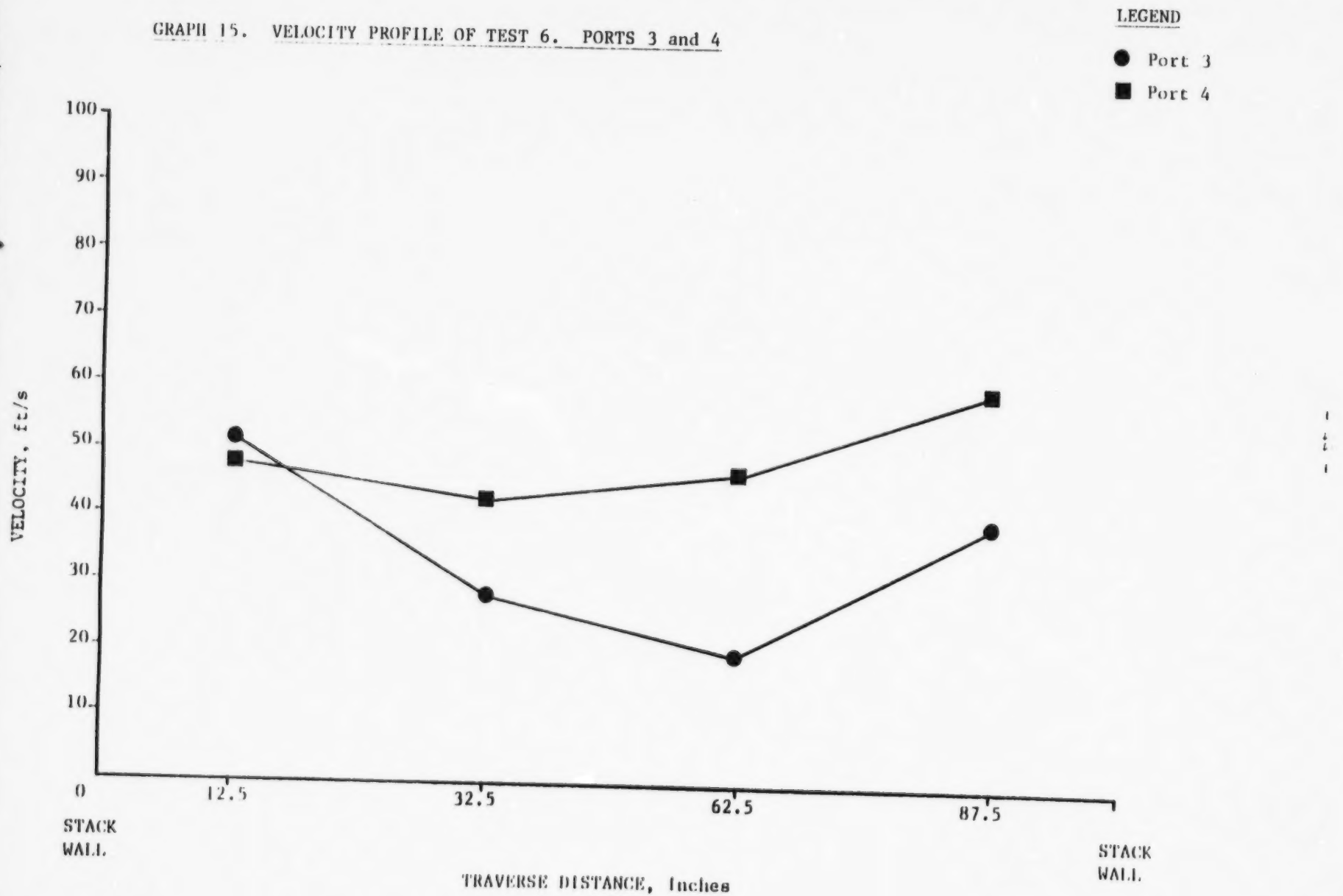
GRAPH 13. VELOCITY PROFILE OF TEST 5. PORTS 3 and 4



GRAPH 14. VELOCITY PROFILE OF TEST 6. PORTS 1 and 2



GRAPH 15. VELOCITY PROFILE OF TEST 6. PORTS 3 and 4



APPENDIX C: FIELD DATA SHEETS

FIELD DATA SHEET

Plant BRANDON GENERATING STATION Location BRANDON, MANITOBA

Stack UNIT 5B BREECHING Test number 1 Date JANUARY 7, 1987

Ambient temperature (°F) - Barometric pressure (in. Hg) 28.96 Time 1:48 P.M. to 4:25 P.M.

Nozzle diameter (in.) 0.185 Probe length/type 10 Ft./stainless steel Stack static pressure (in. H_2O) - 0.15

Probe temperature (°F) ave. 256 Filter holder temperature (°F) ave. 248 Leak check 0.015 CFM @ 15 " Hg Vacuum

Traverse point number	Clock time, start	Stack gas temperature, °F	Gas meter volume, cu. ft.	Velocity pressure, in. H_2O	Orifice pressure drop in. H_2O	Gas meter temperature, °F		Final impinger Temperature, °F	Pump vacuum in. Hg	Isokinetic factor, %
						Inlet	Outlet			
1 - 1	0	326	1.436	0.75	1.906	80	74	47	8	104.8
2	2	331	1.838	1.25	3.164	84	74	44	15	104.1
3	4	335	1.287	1.80	1.477	83	78	52	7	111.3
4	6	335	1.205	1.50	1.228	90	78	49	6	114.1
5	8	331	0.850	0.75	0.616	92	78	51	4	112.4
6	10	325	0.920	0.90	0.747	94	78	52	4	110.4
7	12	325	0.979	1.00	0.830	98	78	52	4	111.1
8	14	326	0.742	0.60	0.498	98	78	55	4	108.7
2 - 1	16	328	0.979	1.00	0.832	94	82	54	5	111.4
2	18	334	0.965	1.00	0.830	98	82	53	5	109.7
3	20	343	1.035	1.15	0.938	104	82	54	6	109.8
Average or total										

Traverse point number	Clock time, start	Stack gas temperature, °F	Gas meter volume, cu. ft.	Velocity pressure, in. H_2O	Orifice pressure drop in. H_2O	Gas meter temperature, °F		Final impinger Temperature, °F	Pump vacuum in. Hg	Isokinetic factor, %
						Inlet	Outlet			
2 - 4	22	340	1.115	1.30	1.067	106	82	54	7	110.9
5	24	340	1.165	1.35	1.108	105	83	55	7	113.8
6	26	338	1.105	1.25	1.028	104	83	58	7	112.1
7	28	336	1.045	1.15	0.950	100	84	61	7	110.6
8	30	335	1.045	1.15	0.953	100	83	63	7	110.7
3 - 1	32	335	0.995	1.00	0.826	93	86	60	6	113.4
2	34	344	0.890	0.85	0.699	100	85	58	6	109.2
3	36	345	0.859	0.80	0.656	104	85	56	6	109.0
4	38	345	0.930	0.90	0.738	107	85	55	6	111.1
5	40	343	0.886	0.85	0.699	108	85	54	6	108.6
6	42	342	0.845	0.75	0.617	109	85	54	6	110.1
7	44	341	0.838	0.75	0.618	109	86	54	6	109.0
8	46	340	1.000	1.05	0.868	110	86	53	7	109.9
4 - 1	48	336	0.796	0.65	0.542	100	87	58	5	111.6
2	50	347	0.839	0.75	0.617	105	88	54	5	109.7
3	52	352	0.667	0.50	0.408	106	87	54	5	107.1
4	54	349	0.500	0.35	0.286	104	87	56	3	95.9
5	56	347	0.220	0.15	0.123	100	85	57	2	64.7
6	58	345	0.252	0.15	0.123	100	85	58	2	74.2
7	60	344	0.573	0.40	0.328	104	86	55	4	102.7
Average or total										

Traverse point number	Clock time, start	Stack gas temperature, °F	Gas meter volume, cu. ft.	Velocity pressure, in. H_2O	Orifice pressure drop in. H_2O	Gas meter temperature, °F Inlet	Gas meter temperature, °F Outlet	Final impinger Temperature, °F	Pump vacuum in. Hg	Isokinetic factor, %
4 - 8	62	343	0.916	0.90	0.741	110	86	51	6	108.8
5 - 1	64	347	0.294	0.20	0.165	94	86	59	1	75.3
2	66	354	0.670	0.50	0.407	100	88	56	3	108.3
3	68	355	0.264	0.20	0.165	98	87	56	2	67.6
4	70	353	0.164	0.10	0.081	96	85	58	1	59.5
5	72	352	0.237	0.15	0.122	95	83	58	1	70.3
6	74	350	0.290	0.20	0.162	96	84	57	2	74.3
7	76	348	0.519	0.35	0.285	98	84	55	3	100.5
8	78	348	1.040	1.15	0.938	106	86	51	7	110.1
6 - 1	80	338	0.785	0.60	0.496	98	84	57	5	115.2
2	82	349	0.886	0.80	0.658	103	86	55	6	112.8
3	84	369	0.783	0.65	0.519	105	86	54	5	111.6
4	86	370	0.547	0.35	0.279	105	86	54	3	106.3
5	88	368	0.308	0.20	0.160	100	86	56	2	79.5
6	90	367	0.537	0.35	0.278	100	83	56	3	105.0
7	92	366	0.384	0.25	0.199	100	84	55	3	89.8
8	94	366	0.466	0.30	0.239	106	84	55	3	98.1
7 - 1	96	369	1.070	1.20	0.956	98	86	53	8	113.3
2	98	377	1.141	1.35	1.069	101	87	50	8	114.0
Average or total										

Traverse point number	Clock time, start	Stack gas temperature, °F	Gas meter volume, cu. ft.	Velocity pressure, in. H_2O	Orifice pressure drop in. H_2O	Gas meter temperature, °F		Final impinger Temperature, °F	Pump vacuum in. Hg	Isokinetic factor, %
						Inlet	Outlet			
7 - 3	100	384	1.109	1.30	1.018	105	86	50	8	113.0
4	102	383	1.035	1.10	0.862	106	86	50	8	114.5
5	104	379	1.115	1.35	1.062	107	86	50	8	107.4
6	106	376	1.220	1.60	1.264	108	86	50	8	111.3
7	108	374	0.940	0.90	0.713	108	86	51	8	114.1
8	110	373	1.362	2.00	1.590	109	86	49	8	111.0
Average or total	112	349	46.888	0.82	0.728	-		-	-	103.6

FIELD DATA SHEET

Plant BRANDON GENERATING STATION Location BRANDON, MANITOBA

Stack UNIT 5B Breeching Test number 2 Date January 7, 1986

Ambient temperature (°F) - Barometric pressure (in. Hg) 28.85 Time 6:27 P.M. to 8:50 P.M.

Nozzle diameter (in.) 0.185 Probe length/type 10 ft./Stainless Steel Stack static pressure (in. H_2O) -0.15

Probe temperature (°F) ave. 279 Filter holder temperature (°F) ave. 297 Leak check 0.002 CFM @ 15" Hg Vacuum

Traverse point number	Clock time, start	Stack gas temperature, °F	Gas meter volume, cu. ft.	Velocity pressure, in. H_2O	Orifice pressure drop in. H_2O	Gas meter temperature, °F		Final impinger Temperature, °F	Pump vacuum in. Hg	Isokinetic factor, %
						Inlet	Outlet			
1 - 1	0	338	0.875	0.85	0.610	91	85	53	4	108.8
2	2	345	1.109	1.45	1.036	98	85	49	6	105.5
3	4	345	1.225	1.75	1.250	102	86	48	7	105.6
4	6	342	1.027	1.20	0.860	104	86	50	5	106.5
5	8	336	0.751	0.65	0.469	103	86	51	4	105.4
6	10	330	0.857	0.85	0.619	103	84	52	5	105.0
7	12	330	0.748	0.65	0.473	103	84	52	4	104.6
8	14	331	0.509	0.35	0.254	100	82	53	4	97.6
2 - 1	16	334	0.940	1.00	0.724	92	86	52	5	107.3
2	18	340	0.999	1.15	0.828	98	86	49	5	106.2
3	20	343	0.951	1.05	0.751	102	86	49	5	105.6
Average or total										

cont'd...

Traverse point number	Clock time, start	Stack gas temperature, °F	Gas meter volume, cu. ft.	Velocity pressure, in. H_2O	Orifice pressure drop in. H_2O	Gas meter temperature, °F		Final impinger Temperature, °F	Pump vacuum in. Hg	Isokinetic factor, %
						Inlet	Outlet			
2 - 4	22	343	1.000	1.15	0.823	104	86	49	5	106.0
5	24	340	1.100	1.40	1.008	106	85	49	6	105.4
6	26	337	1.115	1.45	1.047	107	85	50	6	104.7
7	28	335	0.840	0.80	0.579	105	84	51	4	106.2
8	30	332	0.911	0.95	0.690	105	84	51	5	105.4
3 - 1	32	331	1.023	0.95	0.685	96	84	51	4	119.4
2	34	336	0.750	0.80	0.578	100	85	50	4	95.3
3	36	340	0.892	0.95	0.681	103	85	50	4	103.9
4	38	339	1.107	1.40	1.006	107	85	49	5	105.8
5	40	337	0.710	0.60	0.432	105	85	49	3	103.6
6	42	335	0.932	1.00	0.723	106	85	50	5	105.3
7	44	333	0.964	1.05	0.762	108	85	50	5	105.8
8	46	331	0.855	0.85	0.619	107	85	50	4	104.2
4 - 1	48	323	0.841	0.80	0.581	97	82	52	4	106.4
2	50	335	0.756	0.70	0.503	100	82	50	4	102.8
3	52	338	0.650	0.55	0.394	102	83	49	4	99.5
4	54	336	0.800	0.75	0.540	105	83	50	4	104.5
5	56	333	0.680	0.55	0.397	104	83	50	4	103.7
6	58	331	0.600	0.50	0.363	103	83	51	4	95.9
7	60	330	0.598	0.50	0.363	104	82	51	3	95.4
Average or total										cont'd...

Traverse point number	Clock time, start	Stack gas temperature, °F	Gas meter volume, cu. ft.	Velocity pressure, in. H_2O	Orifice pressure drop in. H_2O	Gas meter temperature, °F Inlet	Gas meter temperature, °F Outlet	Final impinger Temperature, °F	Pump vacuum in. Hg	Isokinetic factor, %
4 - 8	62	328	0.834	0.80	0.581	105	83	51	4	105.1
5 - 1	64	323	0.314	0.20	0.146	90	80	59	1	80.1
2	66	335	0.625	0.50	0.358	91	80	55	2	101.5
3	68	335	0.438	0.30	0.215	96	80	54	2	91.3
4	70	334	0.374	0.25	0.179	96	80	55	2	85.4
5	72	331	0.443	0.30	0.216	97	80	54	2	92.0
6	74	328	0.200	0.15	0.108	94	79	55	1	58.9
7	76	326	0.546	0.40	0.284	96	80	53	2	98.1
8	78	325	0.512	0.35	0.254	99	80	52	2	98.0
6 - 1	80	323	0.718	0.60	0.431	92	80	60	2	105.5
2	82	325	0.850	0.85	0.617	96	80	60	3	104.9
3	84	337	0.720	0.60	0.427	98	80	59	3	106.2
4	86	332	0.439	0.30	0.215	97	80	60	2	91.3
5	88	328	0.419	0.25	0.181	95	80	60	1	95.3
6	90	327	0.137	0.10	0.072	92	78	60	1	49.4
7	92	325	0.354	0.25	0.181	93	78	60	1	80.8
8	94	322	0.677	0.55	0.400	98	79	57	2	103.4
7 - 1	96	330	0.829	0.75	0.541	83	80	56	2	110.4
2	98	336	0.862	0.90	0.645	85	80	54	3	105.1
Average or total										

cont'd...

Traverse point number	Clock time, start	Stack gas temperature, °F	Gas meter volume, cu. ft.	Velocity pressure, in. H_2O	Orifice pressure drop in. H_2O	Gas meter temperature, °F		Final impinger Temperature, °F	Pump vacuum in. Hg	Isokinetic factor, %
						Inlet	Outlet			
7 - 3	100	342	0.838	0.85	0.602	89	80	53	2	105.1
4	102	338	0.700	0.60	0.427	92	80	53	2	104.0
5	104	330	0.915	1.00	1.721	94	80	53	2	104.9
6	106	326	1.061	1.30	0.940	97	78	54	4	106.1
7	108	325	1.084	1.35	0.976	100	80	57	5	105.7
8	110	323	0.984	1.10	0.801	100	80	59	4	106.2
Average or total	112	333	42.988	0.77	0.574	-		-	-	100.6

FIELD DATA SHEET

Plant BRANDON GENERATING STATION Location BRANDON, MANITOBA

Stack UNIT 5B Breeching Test number 3 Date January 8, 1986

Ambient temperature (°F) - Barometric pressure (in. Hg) 28.43 Time 9:39 A.M. to 11:55 A.M.

Nozzle diameter (in.) 0.185 Probe length/type 10 ft/Stainless Steel Stack static pressure (in. H_2O) -0.15

Probe temperature (°F) ave. 286 Filter holder temperature (°F) ave. 255 Leak check 0.015 CFM @ 15 " Hg Vacuum

Traverse point number	Clock time, start	Stack gas temperature, °F	Gas meter volume, cu. ft.	Velocity pressure, in. H_2O	Orifice pressure drop in. H_2O	Gas meter temperature, °F		Final impinger Temperature, °F	Pump vacuum in. Hg	Isokinetic factor, %
						Inlet	Outlet			
1 - 1	0	328	0.903	0.90	0.641	75	74	55	4	110.4
2	2	328	1.091	1.45	1.033	81	73	52	5	104.7
3	4	327	1.148	1.55	1.105	87	72	51	5	106.1
4	6	324	0.922	1.00	0.714	90	72	52	5	105.5
5	8	318	0.672	0.55	0.395	89	72	54	3	103.2
6	10	311	0.743	0.65	0.473	91	72	56	3	104.3
7	12	312	0.714	0.60	0.437	92	72	57	3	104.3
8	14	314	0.631	0.50	0.363	93	72	56	4	101.0
2 - 1	16	317	0.818	0.75	0.543	91	72	56	4	107.4
2	18	322	0.923	1.00	0.721	93	74	55	4	105.0
3	20	324	0.966	1.10	0.789	97	75	55	5	104.4
Average or total										

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Traverse point number	Clock time, start	Stack gas temperature, °F	Gas meter volume, cu. ft.	Velocity pressure, in. H_2O	Orifice pressure drop in. H_2O	Gas meter temperature, °F Inlet	Gas meter temperature, °F Outlet	Final impinger Temperature, °F	Pump vacuum in. Hg	Isokinetic factor, %
2 - 4	22	324	0.998	1.15	0.826	100	75	55	5	105.2
5	24	324	1.099	1.40	1.006	101	75	56	5	104.9
6	26	321	1.111	1.45	1.046	102	75	57	5	104.0
7	28	317	0.890	0.90	0.655	102	75	58	4	105.2
8	30	319	0.804	0.75	0.543	101	76	58	4	104.3
3 - 1	32	327	0.655	0.50	0.359	89	78	58	3	105.5
2	34	329	0.921	1.00	0.718	96	78	55	5	104.5
3	36	329	0.933	1.00	0.718	98	78	55	5	105.7
4	38	327	1.100	1.45	1.045	100	78	55	6	103.3
5	40	327	1.223	1.70	1.225	103	78	56	6	105.8
6	42	325	0.797	0.70	0.506	101	78	57	4	107.2
7	44	325	0.942	1.00	0.722	103	78	57	5	105.8
8	46	324	1.046	1.25	0.904	104	78	57	6	105.1
4 - 1	48	329	0.892	0.90	0.644	95	78	55	4	106.8
2	50	330	0.860	0.85	0.611	99	79	55	5	105.5
3	52	332	0.773	0.70	0.502	100	80	55	4	104.4
4	54	330	0.689	0.55	0.396	100	79	55	4	104.8
5	56	329	0.684	0.55	0.396	100	79	56	4	104.2
6	58	327	0.836	0.80	0.576	102	79	55	4	105.1
7	60	327	0.755	0.65	0.469	102	79	55	4	104.3
Average or total										

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Traverse point number	Clock time, start	Stack gas temperature, °F	Gas meter volume, cu. ft.	Velocity pressure, in. H_2O	Orifice pressure drop in. H_2O	Gas meter temperature, °F		Final impinger Temperature, °F	Pump vacuum in. Hg	Isokinetic factor, %
						Inlet	Outlet			
4 - 8	62	326	0.853	0.85	0.615	102	80	56	4	103.9
5 - 1	64	331	0.544	0.35	0.253	92	81	57	3	104.3
2	66	336	0.688	0.55	0.395	94	81	55	3	105.4
3	68	336	0.528	0.35	0.250	95	80	55	3	101.5
4	70	335	0.217	0.15	0.107	92	78	57	1	64.0
5	72	332	0.140	0.10	0.072	90	77	62	1	59.4
6	74	330	0.304	0.20	0.143	92	77	62	1	77.4
7	76	329	0.462	0.30	0.215	95	78	60	2	95.7
8	78	329	0.779	0.70	0.502	100	80	56	4	105.0
6 - 1	80	330	0.772	0.65	0.467	92	80	57	4	108.7
2	82	340	0.810	0.75	0.534	96	80	55	4	106.5
3	84	342	0.808	0.75	0.532	100	80	55	5	106.2
4	86	339	0.478	0.30	0.213	97	80	56	4	99.1
5	88	337	0.453	0.30	0.214	97	80	59	3	93.9
6	90	333	0.654	0.50	0.359	97	80	59	4	104.8
7	92	331	0.689	0.55	0.396	100	79	57	4	105.0
8	94	331	0.885	0.90	0.647	102	80	57	5	105.2
7 - 1	96	340	0.839	0.80	0.568	92	80	57	5	107.2
2	98	343	0.857	0.85	0.603	97	80	56	5	106.1
Average or total										cont'd....

Traverse point number	Clock time, start	Stack gas temperature, °F	Gas meter volume, cu. ft.	Velocity pressure, in. H_2O	Orifice pressure drop in. H_2O	Gas meter temperature, °F Inlet	Gas meter temperature, °F Outlet	Final impinger Temperature, °F	Pump vacuum in. Hg	Isokinetic factor, %
7 - 3	100	343	0.900	0.95	0.673	100	80	56	5	105.1
4	102	342	0.864	0.85	0.603	100	80	56	5	106.5
5	104	338	0.881	0.90	0.642	102	80	57	5	105.2
6	106	335	1.119	1.45	1.038	104	80	57	7	105.0
7	108	334	1.096	1.50	1.075	104	80	57	7	101.0
8	110	334	0.817	0.80	0.574	103	80	59	5	103.1
Average or total	112	329	42.322	0.82	0.585	-		-	-	102.4

FIELD DATA SHEET

Plant BRANDON GENERATING STATION Location BRANDON, MANITOBA

Stack UNIT 5B Breeching Test number 4 Date April 3, 1986

Ambient temperature (°F) - Barometric pressure (in. Hg) 28.85 Time 10:31 A.M. to 11:39 A.M.

Nozzle diameter (in.) 0.185 Probe length/type 10 ft./Stainless Steel Stack static pressure (in. H_2O) -2.0

Probe temperature (°F) ave 275 Filter holder temperature (°F) ave 245 Leak check 0.000 CFM @ 15" Hg Vacuum

Traverse point number	Clock time, start	Stack gas temperature, °F	Gas meter volume, cu. ft.	Velocity pressure, in. H_2O	Orifice pressure drop in. H_2O	Gas meter temperature, °F		Final impinger Temperature, °F	Pump vacuum in. Hg	Isokinetic factor, %
						Inlet	Outlet			
1 - 1	0	358	0.900	0.50	0.348	85	79	64	3	102.1
2	3	365	1.185	0.85	0.582	93	79	60	4	102.9
3	6	352	1.516	1.35	0.940	100	79	57	5	102.9
4	9	346	0.999	0.60	0.422	100	79	61	4	101.3
2 - 1	12	351	1.242	0.90	0.633	94	81	62	4	103.6
2	15	360	1.436	1.20	0.825	100	81	60	5	103.8
3	18	347	1.363	1.05	0.740	105	82	61	5	103.9
4	21	344	1.435	1.15	0.816	107	82	62	5	104.2
3 - 1	24	347	1.061	0.65	0.461	96	83	67	5	103.5
2	27	355	0.571	0.30	0.209	98	83	67	3	82.2
Average or total										

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Traverse point number	Clock time, start	Stack gas temperature, °F	Gas meter volume, cu. ft.	Velocity pressure, in. H_2O	Orifice pressure drop in. H_2O	Gas meter temperature, °F Inlet	Gas meter temperature, °F Outlet	Final impinger Temperature, °F	Pump vacuum in. Hg	Isokinetic factor, %
3 - 3	30	345	0.377	0.20	0.142	97	83	69	2	66.2
4	33	342	1.109	0.70	0.499	104	83	65	4	103.0
4 - 1	36	351	1.016	0.60	0.425	95	84	65	4	103.4
2	39	350	0.910	0.50	0.354	100	85	63	3	100.8
3	42	345	1.266	0.90	0.641	105	84	62	4	103.8
4	45	340	1.452	1.15	0.825	108	84	61	5	104.4
Average or total	48	350	17.838	0.79	0.554	-		-	-	99.5

FIELD DATA SHEET

Plant BRNADON GENERATING STATION Location BRANDON, MANITOBA

Stack UNIT 5B Breeching

Ambient temperature (°F) - Barometric pressure (in. Hg) 28.85 Test number 5 Date April 3, 1986

Nozzle diameter (in.) 0.186 Probe length/type 10 ft/Stainless Steel Time 1:09 P.M. to 2:09 P.M.

Probe temperature (°F) ave 271 Filter holder temperature (°F) ave 280 Stack static pressure (in. H_2O) -2.0

Leak check 0.002 CFM @ 15" Hg Vacuum

Traverse point number	Clock time, start	Stack gas temperature, °F	Gas meter volume, cu. ft.	Velocity pressure, in. H_2O	Orifice pressure drop in. H_2O	Gas meter temperature, °F		Final impinger Temperature, °F	Pump vacuum in. Hg	Isokinetic factor, %
						Inlet	Outlet			
1 - 1	0	323	0.933	0.50	0.355	98	87	68	3	101.0
2	3	323	1.207	0.80	0.570	105	87	65	4	102.8
3	6	319	1.420	1.10	0.785	110	87	63	4	102.5
4	9	314	1.130	0.70	0.504	109	87	65	4	101.9
2 - 1	12	319	1.238	0.85	0.608	96	84	65	4	103.3
2	15	322	1.368	1.05	0.746	105	85	60	5	101.9
3	18	319	1.607	1.45	1.037	110	86	60	5	101.2
4	21	317	1.308	0.95	0.681	110	86	60	5	101.5
3 - 1	24	324	1.117	0.70	0.495	94	84	69	4	103.1
2	27	322	0.501	0.25	0.178	96	84	69	2	77.0
Average or total										cont'd...

Traverse point number	Clock time, start	Stack gas temperature, °F	Gas meter volume, cu. ft.	Velocity pressure, in. H_2O	Orifice pressure drop in. H_2O	Gas meter temperature, °F Inlet	Outlet	Final impinger Temperature, °F	Pump vacuum in. Hg	Isokinetic factor, %
3 - 3	30	318	0.261	0.25	0.178	96	84	69	2	51.8
4	33	315	0.494	0.15	0.107	97	84	69	2	75.6
4 - 1	36	338	0.976	0.55	0.377	87	82	65	2	103.3
2	39	328	0.854	0.45	0.315	92	82	65	2	99.0
3	42	323	0.911	0.50	0.352	97	82	66	2	99.2
4	45	315	1.311	0.95	0.679	101	83	63	4	102.8
Average or total	48	321	16.636	0.70	0.498	-		-	-	95.5

FIELD DATA SHEET

Plant BRANDON GENERATING STATION Location BRANDON, MANITOBA

Stack UNIT 5B Breeching Test number 6 Date April 3, 1986

Ambient temperature (°F) - Barometric pressure (in. Hg) 28.85 Time 3:18 P.M. to 4:23 P.M.

Nozzle diameter (in.) 0.186 Probe length/type 10 ft/Stainless Steel Stack static pressure (in. H_2O) -2.0

Probe temperature (°F) ave 260 Filter holder temperature (°F) ave 254 Leak check 0.001 CFM @ 15" Hg Vacuum

Traverse point number	Clock time, start	Stack gas temperature, °F	Gas meter volume, cu. ft.	Velocity pressure, in. H_2O	Orifice pressure drop in. H_2O	Gas meter temperature, °F		Final impinger Temperature, °F	Pump vacuum in. Hg	Isokinetic factor, %
						Inlet	Outlet			
1 - 1	0	318	0.950	0.50	0.355	92	87	68	2	103.0
2	3	316	1.194	0.75	0.536	97	86	67	2	105.2
3	6	312	1.410	1.10	0.787	104	86	62	4	101.7
4	9	306	1.041	0.60	0.433	103	87	61	2	101.2
2 - 1	12	318	1.179	0.75	0.533	97	86	69	2	104.0
2	15	317	1.319	0.95	0.680	106	88	65	3	102.3
3	18	314	1.470	1.15	0.826	110	88	63	4	103.2
4	21	310	1.168	0.75	0.541	111	88	64	3	101.0
3 - 1	24	315	1.093	0.65	0.468	102	88	69	3	102.8
2	27	315	0.394	0.20	0.143	102	88	69	2	66.8
Average or total										Cont'd...

Traverse point number	Clock time, start	Stack gas temperature, °F	Gas meter volume, cu. ft.	Velocity pressure, in. H_2O	Orifice pressure drop in. H_2O	Gas meter temperature, °F		Final impinger Temperature, °F	Pump vacuum in. Hg	Isokinetic factor, %
						Inlet	Outlet			
3 - 3	30	312	0.162	0.10	0.072	100	88	70	2	38.7
4	33	307	0.809	0.40	0.290	107	88	70	2	95.8
4 - 1	36	313	1.002	0.55	0.398	100	88	69	2	102.5
2	39	316	0.866	0.45	0.324	106	90	67	2	97.4
3	42	312	0.988	0.55	0.397	109	90	66	2	99.9
4	45	308	1.293	0.90	0.655	112	90	64	4	101.8
Average or total	48	313	16.338	0.65	0.465	-		-	-	95.5